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The Astronomical Outlook in Germany*

By A. UNSÖLD

Astronomy has shown during the past few years such a rapid and splendid development that it may be appropriate to review it briefly.

The great reflecting telescopes, especially the 100-inch reflector of the Mt. Wilson Observatory have disclosed to our eyes a picture which greatly surpasses even the keenest dreams of speculative philosophers. For the first time in the history of human inquiry we comprehend the world really as a whole, as a "Cosmos." That is the deeper meaning of the magnificent discovery by Dr. Hubble that all the spiral nebulae recede from us with velocities which increase with the distance and for the most remote objects accessible to the 100-inch already approach 1/10 of the velocity of light.

But in order to see how the world in its entirety is made up we ought to penetrate still somewhat farther into the depth of space; we imagine to be able to grasp the secret almost with our hands.

This year the gigantic enterprise of building a 200-inch reflector for Palomar Mountain Observatory has reached successfully its goal. It is an instrument of such enormous dimensions and at the same time of such precision that we may well add it to the seven wonders of the world! Imagine, a structure of nearly 500 tons is made to follow the motion of the firmament so accurately and smoothly that the mirror, itself weighing about 20 tons, is deformed scarcely more than 1/10,000 of a millimeter! The new telescope will penetrate about twice as far into the universe as its predecessors and we may watch with utmost interest what it will report from the unseen depths of the universe.

As a companion of the great reflectors, aiding these in all kinds of survey work, the Schmidt-telescope gains increasing importance. It was invented about 17 years ago by the ingenious optician, Bernhard Schmidt, of the Bergedorf Observatory. Recollecting these old times we should not hesitate to thank Professor Schorr for his initiative in putting this strange genius into the service of our science.

*The original German text of this article was presented as an address of welcome at the first general post-war meeting of German astronomers in Hamburg during the fall of 1948. It is being printed in the "Himmelswelt" (F. Dümmler Verlag, Bonn, Germany). Dr. O. Struve of the Yerkes Observatory had read an advance copy of this address and was so impressed with the balanced picture it gave of recent developments in astronomy and with the genuine desire of the author to re-direct German scientific effort that he recommended the publication of the address in the English translation prepared by Dr. Unsöld.

But not only the construction of telescopes has made progress. Improved and new methods for investigating the light have led to many important discoveries. By means of infrared photographs, W. Baade succeeded in resolving the elliptic nebulae and the inner zones of spiral nebulae. At the same time he showed that all the stars can be divided into two widely different groups: Baade's "population I" corresponds to the Hertzsprung-Russell-diagram which was already familiar to us, while "population II" follows that of the globular clusters. This division clarifies at once a great many problems of stellar statistics and dynamics and it seems that we can tackle now the problem of stellar evolution at a very significant place.

After Stebbins' and Whitford's splendid work on photoelectric stellar photometry the introduction of the photomultiplier tube into astronomical work by Kron means again a revolution. With relatively small instruments one can get an accuracy which widely surpasses that of the past. As a first result we may mention the accurate determination of the limb-darkening for A stars which again enables us to draw conclusions concerning the transport of radiative energy and concerning the continuous absorption coefficient.

Powerful spectrographs utilizing Schmidt cameras have disclosed the distribution of rotational velocity and thus of mass within spiral nebulae. In our own spiral, the galaxy, this is accessible to us only rather indirectly. We scarcely need to emphasize how important these things are for the study of stellar evolution.

Then the conventional range of wave lengths in stellar spectroscopy has been extended toward both sides. Ultraviolet spectrographs of great dispersion have provided us with new information on the structure and chemical composition of stellar atmospheres and of the interstellar gas.

By means of V-2 rockets the solar spectrum has been extended to 2200 Å and we hope that the Lyman region will soon be reached. In the infrared the lead-sulfide cell which has been developed during the war is now *the* measuring instrument. A photometric atlas of the infrared solar spectrum with high dispersion is in preparation at the McMath Solar Observatory. In the atmosphere of Mars Kuiper recently discovered carbon dioxide and finally proved the white polar caps to be real ice.

Then the application of new ideas to several kinds of familiar astronomical objects resulted in important discoveries. In close binaries and eclipsing variables O. Struve discovered streams of gas between the two components which indicate that they do not only circle around each other. Special objects like the Wolf-Rayet eclipsing binary V 444 Cygni may finally provide the solution to the problem of certain rare types of spectra.

The discovery of strong magnetic fields within the atmospheres of

several stars by H. W. Babcock is already so well known that it needs scarcely to be mentioned.

In solar physics B. Lyot's ingenious invention of the coronagraph has opened up quite new pathways of research. During the I.A.U. meeting in Zürich we could admire his new $H\alpha$ interference filter, isolating a strip of only about 1 Å in width so that even with moderate seeing one can easily see the hydrogen flocculi and filaments on the solar disc. Their radial velocities can at once be read from a turning knob. It is really an optical miracle to which B. Edlén's identification of the coronal lines may well be added. In America McMath and his collaborators using quite a different technique have achieved a similar perfection in photographing the rapidly changing features on the face of our sun.

Besides the "astronomy of the telescope" which at least superficially reminds us of the "good old times" "Radio-astronomy" has recently gained increasing importance. Starting from K. G. Jansky's discovery (1932) and the observations of British and American radar operators during the war we have learned to investigate the Milky Way, the Sun and the meteors through clouds—if necessary—by means of radio receivers in the wave-length range from 15 meters to 1 cm. To old-time astronomers the world seems here to be turned upside down. In the range of meter-waves the Sun is almost out-shone by the Milky Way. Solar eruptions—scarcely perceptible in white light—surpass the radiation of the whole solar disc by many powers of ten. Meteor showers can now be observed in full daylight near the sun more completely by radar sets than formerly in the clearest night.

But now some people will say, how shall we in Germany ever again compete with these achievements of foreign countries? This question, ladies and gentlemen, I think is completely wrong in itself. We shall not and do not want at all to enter into competition with our colleagues of other countries, but we shall and want to collaborate with them.

A science which comprises the whole universe cannot isolate itself country by country; its element is international cooperation. In this respect—as in all times—personal contact is of first-order importance; as to organization we see the I.A.U. working eagerly and successfully. In the name of my German colleagues I should like to express our heartiest thanks to the astronomers abroad for having resumed the exchange of scientific publications in such a fine way, that now the war-time gaps of our libraries are closed to a considerable extent. We are also under great obligation because in spite of all formal difficulties it was made possible for several of us to attend the important meeting of the I.A.U. in Zürich. These magnificent days and the kind hospitality of Professor Waldmeier and his countrymen will remain long in our memories.

The great kindness of the other countries means for us also a great responsibility. Only such scientific papers have the right of existence,

which reach international standards of quality. It would have no sense —as some young colleagues after their return from the war may have thought—to continue now where they had left off ten years ago. We have seen the enormous progress which our science has made since. Certainly, it will not be easy to take part in the modern development; but it *must* be possible because this is *the* vital problem of our science.

In this connection I may be allowed to say a few words about the medium of scientific interaction among ourselves and our foreign colleagues, the German periodicals. The practical difficulties of the publishers are still very great and the prices, compared with those of other countries, are very high. In our country one hears mostly complaints about long delays in publishing; nearly all the foreign colleagues with whom I spoke in Zürich were astonished that it went so fast. Let us therefore take—following an approved astronomical procedure—the arithmetical mean value! For the editors (their job is not one to be envied!) there results the necessity of returning for revision or of refusing everything that does not contain a real progress of research. It would be quite senseless to publish nervously innumerable little "fillers." "Non multa, sed multum" should be our motto.

In our endeavor towards the reconstruction of German science we unfortunately need also practical means. After the collapse of the previous administration this means essentially that we need money. And that is nowadays quite a rare article! We are grateful to the educational department of Hamburg that it has always remained aware of the great responsibility connected with the possession of the greatest observatory of present-day Germany. But in other parts of Germany conditions are more than sad. Again and again one can hear opinions like this: "Astronomy certainly is a very interesting science; but spending money for it—that may be proper for the rich Americans; we cannot afford that any more." To these pessimists I want to say quite bluntly: Even in America one does not find the money on the street. But the leading persons of this country are deeply convinced of the enormous importance of every kind of scientific research not only for this country but for all mankind. And with a little consideration it is easily seen that the various branches of research are so closely connected that they can only be promoted together. The whole science of mechanics, our optical techniques, etc., have arisen in the domain of astronomy. On the other hand, the latter has made use, with the greatest of profit, of modern electronics.

That for us in Germany research is particularly necessary and must therefore be promoted should be evident to every sensible person. Without new ideas it will never be possible to provide our population, compressed into half its former space, with labor and with the most necessary articles for living. If we may at all dare to think for some years ahead then only one thing is certain: Either we start and maintain research as the basis of our living or a large percentage of our popula-

tion is condemned to perish. A vigorous promotion of research seems to me especially to be much more fruitful than the daring and costly pedagogical experiments of some provinces which under the present conditions can only lead to a further lowering of our educational standards. For the natural scientist trained to see reality without prejudice it is again sad to notice how little many of our present-day politicians have learned in these questions from the mistakes of their predecessors.

Generally the naturalist does not like to make much ado about his personal affairs or to meddle into political affairs. He is wholly dominated by the feeling and the admiration for the works of nature which is so infinitely greater than everything that man may devise or create. And he gives his results to mankind without asking who might use them for his practical advantage. Might we then not be entitled to hope that the responsible political and administrative authorities will feel obliged to take care of science as best they can.

And now I come to the end. An extensive program awaits us. The task of our meeting is—as I have said already—primarily the exchange of scientific results and experience by mean of lectures and discussions. May they bear good fruit!

On the Variability of Chi Ophiuchi

By JOSEPH ASHBROOK

It was noticed in 1941 that the Be star χ Ophiuchi was then about half a magnitude brighter visually than the value $4^m.85$ printed in the Revised Harvard Photometry.[1] Accordingly, attention was called to the star as probably variable,[2] and the discrepancy was confirmed by H. Menze.[3] In 1944 Guthnick and Schneller[4] included χ Ophiuchi in List 41 of stars recognized as definitely variable by the Variable Star Commission of the Astronomische Gesellschaft. Observations by M. Zverev[5] which they cited as confirmation however refer not to χ but to κ Ophiuchi.

To clarify the question whether this star is variable, I have examined all of the available visual observations of brightness made since 1870. All the magnitudes cited below have been reduced to the Harvard Visual System. This conversion was made, if the original observation was published in detail, simply by taking the magnitudes of the comparison stars from *Harvard Annals* **50**. For several old catalogues I have derived approximate systematic corrections. These corrections are such as to make the mean of the catalogue magnitudes equal to the mean of the Harvard visual magnitudes for the 5 nearby stars ρ, ψ, ϕ, ω Ophiuchi and ν Scorpii.

There are 10 series of observations of χ Ophiuchi, which we shall now summarize briefly.

The Observational Material

1. B. A. Gould[6] at Córdoba, Argentina, found 4.4 mag. Neither the number of estimates nor the epoch of observation is printed, but the date was probably within a year or two of 1873. The reduction to the Harvard system applied was —0.2 mag.

2. J. E. Gore.[7] A single estimate on 1875 May 5, 4.4 mag.

3. J. Franks.[7] A single estimate on 1878 Apr. 27, 4.4 mag.

4. E. C. Pickering.[8] χ Ophiuchi was measured on 6 nights in 1880-82 with the 2-inch meridian photometer at Harvard, and on 8 nights in 1884-99 with the 4-inch photometer.

1880	June	21	5.0 mag.	1884	July	16	5.1 mag.
1881	June	19	5.6		July	22	5.1
	July	5	4.9	1893	June	28	4.63
1882	June	9	5.2		June	29	4.70
	June	16	4.9	1894	June	30	4.82
	June	22	4.5	1899	Aug.	10	4.48
1884	June	30	5.1		Aug.	11	4.60

The large scatter in 1880-82 is probably explained by the large accidental errors which occurred in observations with the 2-inch photometer; according to Zinner[9] the mean error of a single measure with this instrument was $\pm$0.22 mag. We conclude from the Harvard measures that in 1880 χ Ophiuchi averaged 5.0 mag., in 1881, 5.3$\pm$ mag.; in 1882, 4.9 mag.; in 1884, 5.1 mag.; in 1893-4, 4.72 mag.; and in 1899, 4.54 mag.

5. Edwin F. Sawyer[10] made 9 observations in 1882-88. These were step estimates reduced with comparison star magnitudes taken from the *Uranometria Argentina;* only the final magnitudes are published. I have brought these into the Harvard System by adding —0.2 mag.

1882	July	3	4.8 mag.	1888	June	2	4.85 mag.
(1884	July	16	4.4)		June	3	4.75
1886	June	5	4.6		June	4	4.75
1887	June	13	4.7		June	9	4.7
	June	14	4.45				

Sawyer's magnitude for 1884 July 16 is apparently erroneous, as it disagrees badly with the Harvard magnitude 5.1 measured on the same night with 4-inch photometer; we shall reject it. The remaining estimates agree well with the Harvard measures. We conclude from Sawyer's data the following annual mean magnitudes of χ Ophiuchi: 1882, 4.8 mag.; 1886, 4.6 mag.; 1887, 4.6 mag.; 1888, 4.8 mag.

6. J. Ashbrook. Estimates on 11 photovisual patrol plates taken at Harvard from 1915 to 1921. For comparison stars ν Scorpii, ϕ and ψ Ophiuchi were used.

1915	Mar.	17	4.35 mag.	1918	July	24	4.35 mag.
	July	28	4.35	1919	Aug.	13	4.36
	Sept.	20	4.34		Sept.	20	4.42
1916	July	16	4.28	1920	Aug.	30	4.34
1918	Mar.	26	4.34	1921	July	22	4.44
	July	22	4.38				

There is no suggestion of a change in brightness during this interval. The following annual means can be formed: 1915, 4.35 mag.; 1916, 4.28 mag.; 1918, 4.36 mag.; 1919, 4.39 mag.; 1920, 4.34 mag.; 1921, 4.44 mag.

7. J. Ashbrook. Between 1940 Apr. 28 and 1948 Aug. 27 I have made 120 visual estimates of χ Ophiuchi. Those of 1940 and 1941 have

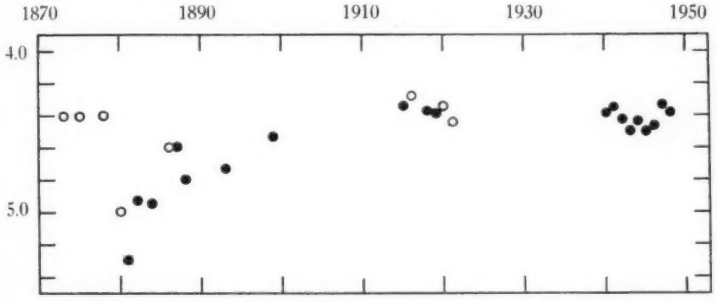

FIGURE 1

Visual Light Curve of χ Ophiuchi 1873-1948. The plotted points are annual means. Filled circles are the means of two or more observations, open circles single observations.

already been published,[2] with a description of the methods used. The changes, if any, are so slow that annual means will suffice.

1940	4.38 mag.	(2)	1944	4.44 mag.	(27)
1941	4.33	(15)	1945	4.50	(13)
1942	4.42	(19)	1946	4.46	(6)
1943	4.53	(27)	1948	4.38	(11)

8. Ohio Observers.[2] 5 estimates made in 1941 by J. J. Nassau, S. W. McCuskey, and E. C. Cherrington, Jr., give the mean 4.41 mag.

9. H. Menze.[3] His observations of 1942 are not accessible to me. The mean of 13 estimates in 1943 is 4.45 mag.

10. Richard Petzold. I am indebted to this observer for a transcript of his 28 unpublished estimates made in 1946 and 1947. Both binoculars and naked eye were used; the variable was interpolated to the nearest 0.1 mag. into the sequence ν Scorpii = 4.2 mag., ϕ Ophiuchi = 4.4 mag., and ψ Ophiuchi = 4.6 mag. The internal mean error of a single observation is $\pm$0.10 mag. Petzold's series gives no indication of change during the interval covered; the annual means are 1946, 4.45 mag. (4 observations) and 1947, 4.33 mag. (24 observations).

CONCLUSIONS

From these rather sparse observations the following results can be inferred. The normal visual brightness of χ Ophiuchi is 4.4 mag. on the Harvard System, and not 4.85 mag. as given by the Revised Harvard Photometry. The star can remain for decades at normal

brightness. Between 1878 and 1880 the star faded from 4.4 mag. to 5.0 mag., and slowly recovered to normal brightness by 1899, where it has since remained. The concordant testimony of Pickering and Sawyer seems sufficient to establish the reality of this temporary loss of light.

The leisurely and intermittent character of the light variation of χ Ophiuchi seems to render constant attention from variable star observers unnecessary, but certainly this star should be examined annually to detect a possible fresh minimum.

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Errors in Astronomical Spelling

By H. B. RUMRILL

Many books on Astronomy, usually those of popular character, contain erroneous spellings of proper names—men, stars, and places, that because of repetition cannot be attributed wholly to the unfortunate printer or his "devil" scapegrace.

Having had some experience in a printing house I know that the latter individual can be the unwitting cause of errors in letterpress; even the proof readers are not always immune, though some possess sufficient scholarship to enable correction of an author's blunders.

When it comes to the spelling of proper names, it seems to the humble writer that an author who succeeds in getting into print should "know his stuff." It was generous to overlook the coinage of variants of the name of Herschel, at the outset of his career, when, almost entirely unknown, that immortal name was spelled in fanciful ways, arising apparently from guesswork, if not stupidity. Any such present-day misspelling is doubtless a matter of typographic uncertainty, but it still crops out occasionally, as in the doubling of the final letter, making the name read *Herschell*. On the other hand, I have seen *Lassel* for Lassell —an equally careless oversight.

The name of Fraunhofer (simple enough in the original German) has been subjected to arbitrary mutations that must confound the reader unfamiliar with that language. I have seen the "umlaut" placed

without warrant over any but its last vowel; also the insertion of an "e" after the letter "u": thus, Frauenhofer; but it "adds insult to injury" to combine two such errors in one spelling! as *Frauenhöfer*. And one often finds omission of the umlaut from a German name where requisite. Yet, on the contrary, I have seen Vogel rendered *Vögel,* and (believe it or not) Schröter and Mädler as *Schroëter* and *Maëdler*—a sort of double umlaut.

Then, there are names properly spelled in more than one way; thus, Michell, Mitchell, Mitchel; Rutherford, Rutherfurd—each correct in its place, but confusing when interchanged, possibly indicative of nothing more than ineptitude.

In the make-up of newspaper articles, under "whip and spur," one is not surprised to find numerous errors, some of them ludicrous to the intelligent reader. In one article I wrote, supposedly for the latter, my use of the word "however" as an adverb was distorted into a conjunction by separation between commas, and that not successfully, for it did not thus make sense. The compositor evidently knew it not as an adverb, but could have "followed copy"—a wise printer's rule when in doubt.

These errors become more serious when appearing in popular books, intended for instruction, resulting doubtless from insufficient proof reading, and it is seldom that such books append lists of errata. These are reserved for works of greater pretention; why? Competent proof reading can eliminate them all, and it begs the question to say that no books are printed without error, for they can be.

One of the commonest misspellings is that of the famous name Dollond, with the second "o" turned into the letter "a": thus, *Dolland.* I have noticed this transformation in not a few books ranking high in astronomical literature; probably due to ignorance, possibly to the proof reader's lack, notwithstanding first-class printing houses are well equipped with reference authorities. As to this particular fault, I have one of the older Dollond catalogues in which attention is directed to the intentional alteration as a means of imitating their telescopes by engraving the name as *Dolland* on the drawtube. At first this seemed incredible; but I once came across just such an instrument in a pawnshop, refusing to purchase it because, in addition to this attempt to defraud, I found it not well put together. The Dollonds would never have fabricated such a telescope!

Regarding place names I have often wondered why local usage should not govern: Middleburg (Holland), instead of Middleberg; Allegheny rather than Alleghany; Pittsburgh with an "h," etc.

Commoner yet are fast-and-loose variants in star names, due alike to ignorance and typographical sources, and by no means confined to books and atlases of the popular sort. Possibly predilection enters into some of these spellings and forms; at any rate they may be found here and there in publications that should be above suspicion of inaccuracy.

This criticism does not apply to most of the better known star names, which have become standardized (although occasionally there occur departures from conformity), but to the English equivalents of some of the less familiar ones. Why, for instance, Gomelza and Gomeisa for the same star? or similarly Algeiba and Algieba? These and other deviations (some of them self-evident transposition) may have originated through misapprehension, or else dismissed as of minor consequence.

Why the variants of Betelgeuze, or of Altair? It would seem that, with Allen's "Star Names and Their Meanings" as a guide, there should be concurrence in astronomical books otherwise dependable, though questionable assertions are not lacking on subjects that should be treated without positiveness. Except as to palpable errors and inconsistencies one expects, as a matter of course, disparity between the old and the new in astrophysics or in stating distances and dimensions; "heaven is not reached at a single bound." Incidentally, Webb preferred Wega to Vega. How scrupulous Dr. Charles A. Young was in these not unessential details!

Again, as to star names, I have sometimes observed in the same book a discrepancy between text and index; this also with names of persons. Likewise, illustration titles not in agreement with the text. One is led to suspect too much speed in mechanical production—particularly typesetting by machine being chargeable with peculiar keyboard mistakes that should not have escaped correction if the authors had participated in the proof reading instead of treating this as entirely a printer's obligation.

When casual reading of an important chapter discloses inexcusable errors such as seconds (″) for minutes (′), or vice versa, and sometimes a too easy-going style in attempting descent to the level of "vulgar" comprehension, as certain old-time writers approached their public, there would appear to be need for reformation of the guilty authors and publishers. In otherwise good presentations I have noted lapses from desirable strict accuracy in the endeavor to explain matters not at all difficult for the gentle reader to understand.

With a good many, "I saw it in the paper" seems to be sufficient reason for accepting equivocal statements and misprints. True, some of these are trivial and easily recognizable, but when a reputable newspaper can print an astronomical item under the misleading head of "Venus on her Annual Fling" (which actually happened) mild disgust is appropriate on the part of a tolerant public, however inured to sensationalism and exaggeration as functions of the "freedom of the press."

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The Inversion of Gravitation Laws

By CHARLES DILLON PERRINE

The discovery of an inversion of the law of falling bodies in the distances of the planets and satellites from their primaries, and of the second-power law in the distances of the outermost satellites, raises the question of a relation to gravitation. The evidence follows.

The distances of the planets and satellites from their primaries are as the inverse of the law of falling bodies starting from rest. The distances increase outward, away from the source, the primary, whereas the velocity of a falling body increases as it approaches its primary. In the case of the planets the starting point is the orbit of Neptune (or Pluto) and of the satellite systems a point at or near the orbit of the outermost of each system.

If we take the accelerations of a falling body under the Earth's attraction, expressed for convenience in units of 100 feet, we have the results for the planets in the following table.

TABLE I

PLANETS

	Distance	Acceleration	Mean Velocity	O-C
Sun	0			
Mercury	0.387	0.32		+0.067
Venus	0.723	0.64		+0.083
Earth	1.000		0.96	+0.040
Mars	1.53	1.28		+0.25
Asteroids	2.56	2.56		+0.09
Jupiter	5.202	5.12		+0.082
Saturn	9.539	10.24		−0.601
Uranus	19.183	20.48		−1.297
Neptune	30.054		30.72	−0.666
Pluto	39.457	40.96		−1.503

The accelerations are the velocities at the end of the unit of time, the second in this case. The value for the Earth is accidentally close but has no other significance. The accelerations may have any value as long as the ratio is maintained. The relation is general therefore, and as true for the Sun as for the Earth.

The agreement of distances with accelerations for all of the planets except the *Earth* and *Neptune* is remarkably close. These two planets, however, agree just as closely with *mean velocities* and deviate from them in the same direction, but are only the half or less.

There is a very obvious systematic deviation in these residuals which appears to be real and significant. But as it is not linear it cannot be removed simply by using a different value for the acceleration. No attempt to evaluate it is made until more is known of the underlying cause, but it is thought to be due either to the influence of a perturbing body or condition, or perhaps to two originating sources instead of one.

To know whether the relation of distance to the law of falling bodies

is of the planets only or is general, the data for the satellites were examined with the results in Table II.

TABLE II

SATELLITES

		Observed Distance	Law	Acceleration	Mean Velocity	O-C
Earth, Moon		238,840	234,000	234,000		+ 4.84
Mars	I	5,850			5,485	+ 0.36
	II	14,500	14,620	14,620		— .0.12
Jupiter	V	112,500	112,500	112,500		
	I	261	225	225		+ 36
	II	415	450	450		— 35
	III	664	900		675,000	— 11
	IV	1167	1800		1350	—183
	VI	7185	7200	7200		— 15
	VII	7403				+203
	X	7184				— 16
Mean		7256				+ 56
	VIII	14604	14400,000	14400,000		+204
	IX	14678				+278
	XI	14012				—388
Mean		14431				+ 31
Saturn	I	117,000	117,000	117,000		
	II	157			176	— 19
	III	186			176	+ 10
	IV	238	234	234		+ 4
	V	332	468		352	— 19
	VI	771			702	+ 69
	VII	934	936	936		— 2
	VIII	2225	1875	1875		+353
	IX	8000	7488	7488		+512
Uranus	I	120,000	120,000	120		
	II	167			180	— 13
	III	273	240	240		+ 33
	IV	365			360	+ 5
Neptune		221,500	234,000	234,000		— 12.50

These results for the satellites show consistently the same relation to the law of falling bodies as do the planets, from which we conclude that the relation is general.

The outermost satellites, which appear to be the limits of control, are at distances from their primaries which depend not only upon the mass of, and distance from, the primary, but also as the inverse second power of that distance.

The following table gives the results of a comparison of the distances of the outermost satellites of each system with the distance computed from the formula

$$\text{Limiting distance} = Dm \times (D_o/D)^2 = D_o^2 m/D$$

in which

D_o = Distance of *Neptune* = 2791.6 million miles
D = Distance of planet
m = Mass of planet.

TABLE III

	Mass ⊙ = 1	Distance million miles	——Outer Satellite—— Computed miles	Observed miles	O-C miles
Earth	1/332,000	92.9	252,670	238,840	— 13,830
Mars	1/3,093,000	141.5	17,888	14,650	— 3,238
Jupiter	1/1,047	483.3	15,401,000	14,430,000	—971,000
Saturn (8)	1/3,500	886	2,513,170	2,225,000	—288,170
Saturn (9)				8,000,000	
Uranus	1/22,760	1781.9	192,120	365,000	+172,880
Neptune	1/19,500	2791.6	142,780	221,500	+ 78,720

The ninth satellite of Saturn appears to be a freak. This does not weaken, however, the existence of the inverse second power law noted, which is fully established.

These residuals are affected, however, by a progressive increase with distance similar to the law of a body falling from rest under the influence of gravitation, as with the planetary distances, and are affected also by mass.

The discordant residuals for Uranus and Neptune in Table III can be removed by assuming an origin at Pluto instead of Neptune, but which is intolerable for the others. This reveals some sort of difference in the origin of the two.

The divergences of the four can be nearly wiped out by a correction of the form

$$\text{Correction} = du$$

in which

d = Earth's divergence (—13,830)
u = limit of satellite system, ⊗ = 1.0

the values of which and O-C are given in columns 2 and 3 of Table IV.

The residuals from this elimination, column 3, are affected still by a progression of the same inverse falling-body law as exists in the planetary distances. The representation of this progression was effected by least square determinations of the form

$$ax + by + k + n = 0$$

where

a = *mass*, ⊗ = 1.0
b = 1, 2, 4, 8, (12), 16 successively.

Constants derived from all six systems eliminated practically the whole of these residuals but as those of *Uranus* and *Neptune* had been abnormal, constants were derived from the four normal systems. As was to be expected these give a better representation for the four and bring into line *Neptune* also. The constants are for

x, — 4,900 miles (mass)
y, + 8,290 miles (progression)

the corresponding corrections and O-C being given in columns 4 and 5 of Table IV.

TABLE IV

	Observed Divergence	Correction	Corrected ⊗ = 0	Four Comp.	Four O-C
Earth	— 13,830	— 13,830	000	— 5.22	+ 5.22
Mars	— 3,238	— 830	— 2,408	+ 3.51	— 5.92
Jupiter	—971,000	—835,000	—136,000	—135.98	— 0.02
Saturn	—288,170	—296,000	+ 7,830	+ 6.75	+ 1.08
Uranus	+172,880	— 16,800	+189,680	+ 79.31	+110.37
Neptune	+ 78,720	— 12,900	+ 91,620	+111.29	— 19.67

These two inversions of gravitation laws are, therefore, fully established. Whether they are of gravity is a different matter, yet to be determined.

Radical as it is, the most direct explanation is simply that gravitation is of a dual nature, acting as attraction, but under certain conditions or in combination with another "force" or condition is reversed. And this I conceive to be the true one.

The other is that we are not dealing with gravitation but with an entirely different force or condition, which is not logical in view of the necessity in that case of explaining where is gravitation, which has per force to have been present.

Only the future can decide. And it will!

VILLA GRAL. MITRE (TOTORAL) CÓRDOBA, MARCH 13, 1948.

New 100-inch Reflector for Britain's Royal Observatory

By WALTER WOERING

If Sir Isaac Newon, the inventor of the reflector telescope, could see the plans—at present on the drafting boards—for the giant telescope which is to bear his name, he would scarcely recognize this giant as the child of his genius. The mirror is to have a diameter of no less than 100 inches and it is to be equipped with such ingenious accessories that it will be able to follow stellar movements automatically.

In a few years nothing will be left of the most famous observatory in the world, Greenwich, but the name, a museum, and a meridian. The observatory itself is being moved to Hurstmonceaux, Sussex, England, where the work of investigation and observation will be continued without disturbance from surrounding factories, power stations, docks, and electric railways, as has been the case for some time at Greenwich. Telescopes and chronometers, meters, and records have been or are being transported to Hurstmonceaux, a castle more than 500 years old, built by Sir Roger de Fienes, the treasurer of Henry VI, and now considered one of the most beautiful brick buildings in all England.

There will be installed, as a gift from the Government to Science, the new 100-inch Isaac Newton reflector. It will be at the disposal of all astronomers and observatories in Britain, for research purposes and

it is perhaps not too much to expect that the overseas visitors to Britain will be equally interested. The plans are, however, being worked out not in Greenwich or Hurstmonceaux, but at Malvern in southern England by technicians and scientists attached to the Telecommunications Research Establishment (T.R.E.), a unit which during the war played such a decisive part in the evolution of various radar instruments.

At Malvern it was decided that the telescope must be regulated by means of an automatic control device, if it is to carry out its important task satisfactorily. As there was no such control in existence, it had to be specially invented for this purpose, and this work is now in progress.

Electronic Control

The new device, like so much modern apparaus, is fitted with electronic tubes: it is capable of registering the deviation of a star in the field of view of a telescope and automatically setting the mechanism in motion so that the apparent motion of the star is accurately followed by the telescope. Even stars of the ninth magnitude, which are completely invisible to the naked eye, emit sufficient light to operate this highly sensitive apparatus. In cases where photographs of stars are to be taken at regular intervals, the necessary arrangements for doing so can be made quite automatically and without human intervention.

A similar device has already been tried out at Greenwich, where it was fitted to the 13-inch telescope there, so that it can follow the diurnal movement of a star under observation with an accuracy of one-thousandth of a degree.

The rotation of the earth compels the astronomer to keep his telescope constantly in motion in order to follow a star; previously the mechanism was driven by clockwork so that the telescope was trained on the moving star as accurately as possible. Small inaccuracies in the clockwork were corrected by the astronomer making manual adjustments as required. A further source of error arises due to variations in the refraction of light passing through the earth's atmosphere, but no clockwork can take this into account in its movements. The result is blurred photographs.

The electronic device acts independently of inflexible clockwork motors, set at a fixed speed in the original direction; it takes its cue from the star itself under observation and reacts almost instantaneously to the slightest deviation as though it could anticipate the intended movement of the heavenly body.

The introduction of the new device will without doubt lead to greatly increased accuracy in calculating the results of investigations. This is a particularly important point in the question of position determination. The introduction of stellar photography made it possible to measure more accurately the angular distances separating the stars from each other. When a displacement error, even though very minute, takes place, the distances in miles between the stars determined from these measurements may be greatly in error.

An Apparent Earth-Effect upon Sunspot Activity

By H. W. CLOUGH

Various investigators have found what appears to be an Earth-effect upon certain solar phenomena, shown by an annual or semiannual variation in their frequency. Alter[1] has discussed a possible tidal effect of the inferior planets. Bauer[2] averaged monthly sunspot relative numbers for three years at each minimum, a total of 45 years, and obtained a curve with an average range of five relative numbers, having maxima in March and October and minima in January and July.

As a contribution to the subject, this paper presents results of a further analysis of the monthly relative numbers. Other solar data studied were derived from the observations made at the Lyons Observatory, in monthly means from 1889 to 1930; the observations made at the U. S. Naval Observatory from 1930 to date have also been employed. The curves shown are based on monthly values smoothed by the formula, $(a + b + c)/3$.

A selection was made of well-defined secondary maxima and minima in the table of monthly relative numbers, the criterion for selection being that the number should be greater than, or less than, any of the three numbers preceding or following. In the 196 years from 1749 to 1944, the number of maxima and minima thus selected averaged 23 each, per month. The frequency of these selected values for each month, in percentages of their average, is shown in curves 1 and 2, the latter curve being plotted with inverse scale. The average of the two curves is shown in curve 3. This curve has maxima near the equinoxes and minima near the solstices. Bauer's results are thus confirmed by a method which makes use of the entire 196 years.

A further analysis of the relative numbers is afforded by counting the number of times for each of the 12 months that a number showed an increase over that for the preceding month. These numbers were smoothed and reduced to percentages of the yearly average. The results for 1749 to 1844 and 1845 to 1945 are shown in curves 4 and 5, while the average for the whole series is shown in curve 6. The two halves of the series have a general similarity, which, ordinarily, is good evidence for the reality of the variation. Curves 3 and 6 agree in showing the semiannual wave. Both have chief maxima in March and minima in December and show a tendency for the phases to be seven and five months apart. This departure from a symmetrical curve seems real and not due to paucity of data.

The solar observations of the Lyons Observatory, 1889 to 1930, give the number of groups for each month in each hemisphere and their mean areas and latitudes. The ratio of the number of groups in the northern hemisphere to the total number was computed for each month,

MONTHLY VALUES OF SOLAR DATA, IN PERCENTAGES OF THE YEARLY MEAN, SMOOTHED BY 3-MONTH AVERAGES.

(1) Relative numbers, maxima per month, 1749-1943.

(2) Relative numbers, minima per month (scale inverted).

(3) Average of curves 1 and 2.

(4) Relative numbers, increases over preceding month, 1749-1845.

(5) 1846-1943.

(6) 1749-1943.

(7) Group ratios, increases over preceding month, 1889-1930.

(8) Group ratios above 0.50.

(9) Area ratios, increases over preceding month, 1889-1943.

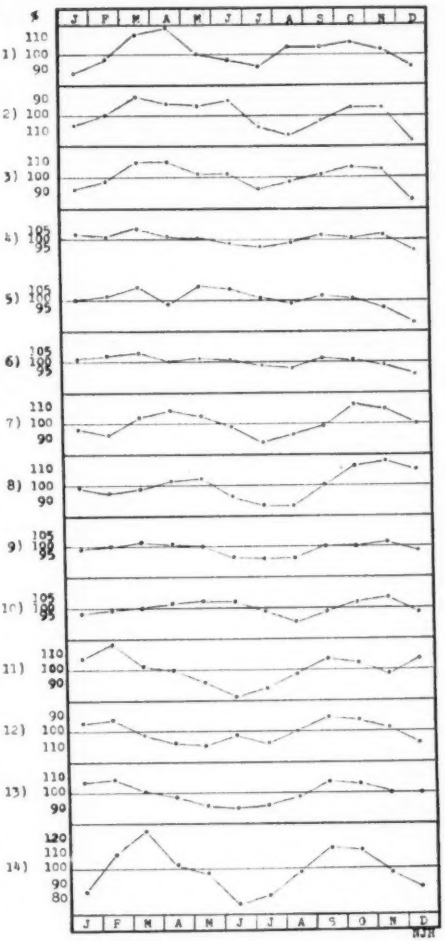
(10) Area ratios above 0.50.

(11) Mean latitude of northern spots, increases over preceding month.

(12) Mean latitude of southern spots, increases over preceding month (scale inverted).

(13) Average of curves 11 and 12.

(14) Magnetically disturbed days, 1906-1924.



likewise the ratio of the northern to the total areas. From the data published by the Naval Observatory since 1930, the monthly ratios of the northern to total areas bring up to date similar ratios from the Lyons Observatory. For convenience, these values will be referred to, hereinafter, as group ratios and area ratios. A ratio above 0.50 denotes an excess of spottedness in the northern hemisphere.

It is found that a change in a ratio from the preceding month is usually followed by the opposite change in the next month, the percent-

age of opposite changes for group ratios being 68, while for area ratios the percentage is 62. These show how quickly the excess of spottedness shifts from one hemisphere to the other. In fact, the correlation between the spotted areas of the two hemispheres, based on monthly data, is negative, amounting to —0.10.

The group ratios are available from 1889 to 1930. The number of increases in these values for each month over the preceding month is expressed as a percentage of the whole, and these percentages are smoothed and shown in curve 7. Next, a count was made of the group ratios above 0.50, and the percentages above 0.50 are shown in curve 8.

The area ratios for the years 1889 to 1942 were treated in the same manner as the group ratios. Curve 9 shows the percentages of increases over the preceding month and curve 10 the percentages of ratios above 0.50. Curves 8 and 10 apparently lag slightly after curves 7 and 9, in accordance with the theoretical expectation. They show that the maximum excess of spottedness in the northern hemisphere occurs in May and November, while the maximum excess in the southern hemisphere occurs in February and August.

As with the relative numbers and the group and area ratios, the month-to-month changes in the mean latitudes of the spots were studied, with the exception of the three years at and after minima, when high and low latitude spots were coexistent. For each hemisphere there was derived the ratio of the number of increases in the latitude over that of the preceding month to the total number of years. Curve 11 shows the ratios for the northern and curve 12, scale inverted, the ratios for the southern hemisphere. Curve 13 is the average of curves 11 and 12, and indicates a tendency for the mean latitude of the entire spotted area to be farthest north in February and September, and farthest south in June and December. These months may be changed by study of a longer record, but the semiannual northward and southward surge, common to both hemispheres, seems real.

The semiannual variation which apparently exists in solar activity is closely analogous to that of terrestrial magnetic disturbances and the aurora. Curve 14 represents the frequency of magnetically-disturbed days, 1906-1924, with maxima near the equinoxes and minima near the solstices.[3]

The question arises as to the reality of the curves here presented. One test for reality is a comparison with random numbers subjected to the same arithmetical processes. Similarity of the two halves of a long record and agreement between curves derived from different data are valid indications of reliability.

With respect to curves 1 and 2, a comparison was made with a series of 200 random numbers having the same mean and dispersion. These numbers were formed by the summing of five random digits, 0-9, with a theoretical mean of 22.5. From these numbers 25 curves were constructed for comparison with curve 3, and it was disclosed that none

of them bore any close resemblance to the solar curve. Most of them showed only one wave, with a range much in excess of that shown by curve 3. The restricted range of this curve is very significant. The additional fact that curves 1 and 2 are similar is also good evidence for their reality. The two halves of the 196-year record, curves 4 and 5, show significant similarities. It is possible that the low December values are due to excessive sky haziness in that month; this deserves further study.

Curves 7 to 10 are independent of any possible sky factor in their origin, and the semiannual variation in these curves is fairly symmetrical. Curves 11 and 12 are derived from different data and their similarity is very significant. Finally, the coexistence of the semiannual variation in all the curves derived from various solar data seems to preclude any possibility of a considerable amount of fortuity existing in them.

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CASTILE, NEW YORK.

The Moon's Other Side

By H. PERCY WILKINS, F.R.A.S.*

SYNOPSIS

This paper points out the difficulty in observing and charting those portions of the lunar surface which, normally concealed, are brought into view by libration. It is illustrated by observations of the mountain peaks visible in profile on the eastern limb under varying conditions of libration.

Of all known facts concerning the moon one of the most remarkable is the manner in which substantially the same side is constantly presented towards the earth. The entire lunar surface may be divided into three regions: (1) that portion always seen, (2) that portion never seen, and (3) the portion alternately brought into and carried out of view by libration. Owing to libration we see, at one time or another, nearly six-tenths of the entire surface of our satellite.

The regions presented to us under conditions of mean libration, *i.e.*, the central portion of the visible hemisphere together with those regions for the most part in view but liable to be carried out of view by libra-

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tion have been mapped but little has yet been attempted in charting the portion of the averted hemisphere for the most part concealed but which is brought into view by libration. The study of these regions is both difficult and important. The very foreshortened aspect under which these regions are seen renders observation difficult but such observations are important because only by careful study can we determine whether the averted hemisphere is of similar nature to that always seen.

People who view the moon through a telescope for the first time frequently fail to realize the mountainous nature of the surface. We are so accustomed to viewing mountains from the side that it requires some mental effort to realize that the lunar mountains are of necessity viewed from above, as though in fact we were suspended in a balloon or a plane far above the surface. As the eye sweeps from the centre towards the limb, or apparent edge of the lunar disc, the mountains are seen more nearly in their true aspect until on the limb itself the peaks can be seen in profile projected against the dark sky.

Along the southern and eastern limb in particular peaks may often be seen in profile as in these regions are situated the great ranges of the Liebnitz, Doerfel, Rook, and D'Alembert mountains. Some of the gigantic peaks are situated on the normally averted hemisphere, the other side, and their occasional visibility is due to libration and, in some measure, to their altitude.

At first sight it would appear to be an easy matter to study these ranges since they are displayed in actual profile, but, as a matter of fact, it is even easier to make a mistake and assign to these ranges peaks which really exist on the walls of craters situated on this side. At all times except when considerable eastern or southern libration exists, so that we can peep around the limb, the peaks visible in profile are merely the highest portions of the walls of well-known craters such as Bailly or Casatus. Great caution is therefore necessary before concluding that peaks seen jutting out from the limb are the tops of mountains on the "other side."

'Round the edge' beyond the sombre Grimaldi and the dark area within Riccioli is the range of the D'Alembert mountains attaining the great altitude of 20,000 feet. One mountain mass sometimes visible on the limb due east of Riccioli is remarkably level, a real 'table mountain' which, on a close view, would greatly surpass in altitude and grandeur the well-known Table Mountain of South Africa.

An illustration, which has been prepared from actual observation, shows the peaks visible in profile on this portion of the limb and is arranged to clearly indicate the effects of libration. The positions of Grimaldi and Riccioli are shown with respect to the various curves each of which represents the appearance on particular dates ranging from No. 1 at extreme eastern libration in longitude, through mean libration to No. 20 at extreme western libration. Curve No. 1 thus shows the peaks visible under the most favorable circumstances and

No. 20 the appearance when conditions are most unfavorable. The peaks shown on the first curves are situated on the 'other side' while those shown on the last few curves are on our side, usually seen as part of a crater-wall but occasionally carried on to the limb.

It is clear that, whatever the libration, peaks are frequently visible in profile on this portion of the limb which may have a bearing on the 'Baily's Beads' often seen just before or just after the totality of solar eclipses. This remarkable phenomenon has been ascribed to the irregularities of the lunar limb, exaggerated by irradiation and there certainly exist mountain peaks on that portion of the moon's disc which covers the last remaining segment of the sun at the commencement of totality. On the opposite or western limb the portions of the averted hemisphere which libration brings into view contain no great ranges. Here the extreme view is limited by the mountainous borders of the grey plains, the Maria, Smythii and Maginus, although one sharp peak may often be seen in profile on the limb a little to the south of Langrenus.

Among the other objects which libration reveals may be mentioned a grey plain to the east of the Mare Humorum, which under the designation of Mare X is shown separately on section 20 of the writer's large lunar map, a fine ring beyond Gauss and isolated peaks beyond the north pole and, at intervals, along both the northwest and northeast limbs. Here and there bright rays can be traced obviously emanating from foci always concealed. One such ray appears around the northwest limb and can be traced towards the Mare Serenitatis.

Much further study is required before our knowledge of the libratory regions can be considered as satisfactory and such observation requires nothing more than a telescope of from 6 to 12 inches in aperture and plenty of patience and perseverance. One remarkable feature already established is the brilliancy of several mountain summits which present an appearance of snow-covered peaks, the gleaming summits being contrasted with the dark grey of the lower slopes.

It cannot be too strongly emphasized that more useful and valuable work can be accomplished by careful observations of the limb regions than by the far too common desultory scrutiny of well-known and well charted formations nearer the centre of the disc. Such observations would result in a substantial contribution to lunar science and the observer be assured of a lasting place in selenographical history.

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The Center of the Universe

Changing Concepts during the Centuries

By OSWALD THOMAS

In the section of Book Reviews in this issue is a review of a revision of a text on Astronomy by the same author. This paper is a translation from a leaflet issued some time ago. The style of the author is indicated by it. The moral injunction at the close is, perhaps, unusual in a scientific paper, but quite characteristic of certain philosophically minded German writers. The translation was made from the German by two students in Carleton College, Miss Ruth Behnke and Miss Marcia Pfau.—EDITOR.

There originated many years ago on a Vienna floor a "table of dimensions" comprising all of the objects of the world arranged in steps in such way that an object ten times larger in diameter than the one below it stands upon each of the steps. At the bottom, the nucleus of the hydrogen atom is the principal figure, and at the top "the entire universe," that is, that which is accessible using modern methods of telescopic measurements. If one progresses on this ladder of dimensions from the smallest to the largest object, then Man, with his immediate surroundings, lies mathematically in the middle. Using a medium which will calculate all measurements in the sense of this heavenly ladder, therefore not one or two or three centimeters or meters or kilometers, but instead one with zero, one with two zeros, or one with three zeros, that is, 10, 100, 1,000, 10,000 centimeters or meters or kilometers, we find that Man is indubitably the true center.

"Man in the center of the Universe!" The knowledge of this is as ancient as mankind itself, and even Adam and Eve, in their Paradise, hardly questioned this principle. However, it is noteworthy that for thousands of years, even though a respectable astronomical knowledge did exist, this prejudice was not discussed in thinking circles. This is true of the Sumarians as well as the Chaldeans, the Chinese, and the Indians. This "self-evident" question was first discussed in Greek times. This, however, was a revolutionary and a selected, isolated, phenomenon. Literally, only once in a hundred years did an idea emerge which advocated the sun as the center of the universe instead of the earth.

In the sixth century before Christ, Pythagoras advocated the idea that the earth revolved around an extra-terrestial body; in the fifth century Philolaus taught that a central fire existed around which our earth revolved, and, opposite it, a dead black earth. An extant sketch shows that this keen statement anticipated the rotation of the earth, and, in fact, the followers of Philolaus taught the idea of earth-rotation. In the fourth century before Christ, Heraclides of Pontus thought of the earth as rotating not only around its own axis but he also con-

jectured a translatory, that is a straight-line, motion in space. In the third century, about 290 years, before Christ, the great astronomer and thinker, Aristarchus of Samos, originated the idea of a heliocentric model of the universe, now known as the Copernican System, and showed us a way in which we could determine, through measurements, the distance of the earth from the sun, the center of the universe.

The ideas mentioned above of course remained completely hidden. How much political prudence on the one hand, and intolerance on the other, hindered the acceptance of this which was thought to be heresy or to what extent the difficulty of coordinating the visual aspect with the theoretical hindered the development of this idea, can now hardly be determined. Actually, Copernicus, eighteen centuries after Aristarchus, developed this system. Since considering the sun rather than the earth as the center of the universe signified a great revolution, there is evidence that the Church, only in the second half of the eighteenth century, removed the principal works of Copernicus from the index of forbidden books.

The question then was—as for many people even now—that of deciding between "truth and untruth," which, since the great German physicist Kirchhoff first set down the goal of all natural sciences, is no longer considered in matters pertaining to astronomy. Kirchhoff stated that the natural sciences consist solely of the description of natural phenomena in the simplest manner possible. Perhaps one could say "in the simplest and most convenient manner."

When the astronomer works with the telescope, he must think Ptolemaically; if he works in the field of the planets, then he must be guided by the Copernican theories. Those who cannot be convinced that the Ptolemaic as well as the Copernican theories are apparently correct need only to observe the magnificent Zeiss Planetarium. In this mechanism the sun, moon, and planetary models revolve according to the Copernican theory, while the illuminated nebulae depicted on the spherical heavens revolve, as realistically as is mechanically possible, according to the Ptolemaic theory.

The center of the universe now becomes—and rightly so—a matter of definition. More conveniently, and for that reason clearer, we shall place the heavy sun "in the center." Now, however, our sun is only one of a million just like it, which in their totality constitute our Milky Way. A center of higher order of magnitude lies, then, in the geometric and the dynamic center of gravity of the Milky Way—or galactic system—whose magnitude as compared with our solar system is as central Europe is to a small coin.

Since the part of the Milky Way in the southern hemisphere shines very brightly, one can ascertain the place where it is most concentrated: between the Hunter and the Scorpion. There, thirty-thousand light years away from the earth, is the center of the galactic universe, around

which we make one complete revolution every two hundred million years.

These dimensions have only recently, in the last century in fact, become familiar to astronomers. Various investigations have been conducted in order to ascertain these dimensions, investigations which today are only of historical interest. Next the central sun was thought to be found in the brightest star, Sirius in Canis Major around which our sun and its sisters revolved. The great philosopher Kant was sympathetic to this conception. Lambert, of Alsace, thought of the picturesque Orion nebula as the center of all suns. Argelander, of the city of Bonn, the creator of a star catalogue, sought the center of the universe in the region of Perseus; Mädler, about one hundred years ago wrote a book in which he calculated a central sun to be in Pleiades. Later an effort to place a massive object in the center was no longer made. In double stars, both components revolve about an empty center of gravity. Indeed it seems as if we could regard a significant Nothing or a very thin medium which we suspect to be in the center of our Milky Way as the center.

Outside of our own, there exist millions of Milky Ways. Now, where does the center of this "universe of all universes," this universe of all spiral nebulae lie? We can give no satisfactory answer, since the form of this material universe is unknown. Its diameter is fully a thousand million light years. There are indications that the "final center"—the reader will perhaps say to himself, the "true center of the universe"—lies in the direction of the Berenices cluster, in a constellation north of Virgo.

According to the purpose of our observation we place—in keeping step with Kirchhoff and according to the rules of the theory of the relativity of motion—the center where it is organically best suited with regard to the methodical unity which we observe. The greater the accuracy with which one is able to carry out his ideas, the easier, the clearer, and the more productive will be the celestial observations. However, let us not forget to place the "center" where it should properly be, in our innermost self. Then, as seen with our living eyes, all the cosmic splendor surrounding us will become truly infinitely beautiful. Then, "an ounce of heart has more value than a pound of knowledge."

The Planets in April, 1949

By RAYMOND H. WILSON, JR.

NOTE: The time employed is Central Standard Time unless otherwise indicated. The phenomena have been chosen and described for the North American continent, and especially for the United States. The basic data have been taken principally from the *American Ephemeris and Nautical Almanac*.

Sun. By the end of this month the sun will have progressed to a declination

nearly 15 degrees north of the equator, that is, about two-thirds of its midsummer amount. A partial eclipse of the sun will occur on April 28 between midnight and 4 A.M., so it will be invisible in America excepting the shores of Labrador and northeastward.

Moon. The phases of the moon will occur as follows:

First Quarter	April	6	7 A.M.
Full Moon		12	10 P.M.
Last Quarter		19	9 P.M.
New Moon		28	2 A.M.

On April 12 will occur a total eclipse of the moon, which will be of almost maximum possible length, since the moon will then also be nearest to the earth. The total phase alone will last from 9:28 to 10:54 P.M.; partial phases from 8:28 to 11:54 P.M. This great length may result in an unusually dark eclipse around the middle, at about 10 P.M.

An occultation of Antares will be visible over the eastern half of the continent on April 16 between 12:25 and 1:20 A.M.

Evening and Morning Stars. Saturn will be near the meridian in the evening; Jupiter just before sunrise.

Mercury. Since it will pass superior conjunction with the sun on the 13th, Mercury will be practically unobservable this month.

Venus. Venus will pass superior conjunction on April 16, so it will be too close to the sun for observation.

Mars. Mars will be too close to the sun for observation.

Jupiter. Jupiter's position will become increasingly favorable for observation in the southeast morning sky.

Saturn. Saturn will be very favorably placed for early evening observation, since it will be south at about 8 P.M.

Uranus. Uranus will be moving very slowly eastward at a position about 3 degrees northeast of ζ Tauri.

Neptune. Neptune will be moving northwestward at about 3 degrees southeast of γ Virginis. Just before sunrise on April 12 the moon will be only a degree west of the planet.

Department of Mathematics, Temple University, Philadelphia, Pa.
February 4, 1949.

Occultation Predictions for April, 1949

(Taken from the *Amerian Ephemeris*)

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result in degrees, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude, using *b*; apply the sum of the products, with its proper sign, to the Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standard Time, six hours, etc.

Date 1949	Star	Mag.	IMMERSION Greenwich C.T. h m	IMMERSION *a* m	IMMERSION *b* m	IMMERSION Angle E from N °	EMERSION Greenwich C.T. h m	EMERSION *a* m	EMERSION *b* m	EMERSION Angle E from N °
Occultations Visible in Longitude +72° 30′, Latitude +42° 30′										
Apr. 3	33 Taur	6.0	1 28.1	−0.2	−1.5	93	2 27.3	0.0	−0.8	250
5	136 Taur	4.5	3 56.0	−0.1	−1.0	80	4 48.7	+0.5	−1.4	290
10	*l* Leon	5.3	6 29.6	+0.1	−2.4	167	7 11.3	−0.6	−1.2	258
16	α Scor	1.2	6 41.2	−1.5	−0.1	120	7 59.2	−1.9	−0.3	280
16	116 B.Scor	6.2	7 46.7	−1.8	−0.3	109	9 6.5	−1.8	−0.8	284
Occultations Visible in Longitude +91° 0′, Latitude +40° 0′										
Apr. 3	33 Taur	6.0	1 27.1	−0.5	−2.8	120	2 19.5	−1.0	+0.5	220
5	406 B.Taur	5.6	3 3.5	−2.3	+2.0	32	3 33.6	+1.0	−4.5	339
5	136 Taur	4.5	3 57.3	−0.2	−1.8	110	4 56.0	−0.1	−1.0	262
7	ω Canc	5.9	7 33.5	−0.4	−0.3	51	8 1.0	+1.1	−2.2	346
13	*h* Virg	5.4	5 46.3	−2.4	+0.3	88	6 41.8	−0.5	−2.0	350
15	169 B.Libr	5.8	11 25.1	−1.2	−1.2	92	12 31.0	−0.9	−1.7	297
16	α Scor	1.2	6 25.2	−0.2	−0.8	155	7 20.4	−2.3	+1.2	253
16	116 B.Scor	6.2	7 19.5	−1.0	−0.3	135	8 31.4	−2.1	+0.2	268
20	40 B.Capr	6.2	10 8.1	−1.8	+2.2	35	11 14.5	−2.3	+0.1	294
Occultations Visible in Longitude +98° 0′, Latitude +31° 0′										
Apr. 5	406 B.Taur	5.6	2 49.6	−1.5	−0.6	80	3 58.5	−0.3	−1.7	293
5	136 Taur	4.5	4 19.4	+0.8	−3.4	152	4 55.5	−1.3	+0.8	222
13	*h* Virg	5.4	5 35.1	−1.6	−0.8	125	6 49.8	−1.5	−1.4	317
15	169 B.Libr	5.8	11 26.2	−1.6	−1.2	106	12 38.2	−1.0	−1.3	285
15	177 B.Libr	6.2	12 14.9	−1.1	−0.9	87	13 19.6	−0.8	−1.7	299
16	116 B.Scor	6.2	7 26.1	+0.6	−2.7	177	8 4.3	−3.8	+2.4	234
20	40 B.Capr	6.2	9 35.9	−1.6	+1.9	58	10 55.7	−2.1	+0.6	279
Occultations Visible in Longitude +120° 0′, Latitude +36° 0′										
Apr. 2	δ Arie	4.5	3 58.6	+0.1	−2.6	120	4 43.6	−0.5	+0.8	213
5	406 B.Taur	5.6	2 4.8	−2.3	−0.2	84	3 29.7	−1.5	−1.3	279
7	ω Canc	5.9	7 27.0	−0.4	−1.5	105	8 25.4	+0.1	−1.6	298
7	4 Canc	6.2	8 6.2	+0.6	−2.4	155	8 46.6	−0.4	−0.6	247
13	*h* Virg	5.4	5 10.0	−0.4	−1.1	154	6 11.1	−1.7	+0.3	283
15	169 B.Libr	5.8	10 39.0	−2.0	−0.7	109	11 58.6	−1.8	−1.3	298
15	177 B.Libr	6.2	11 35.2	−2.2	−0.3	78	12 41.2	−1.6	−2.0	322
21	35 Capr	6.0	11 22.3	−0.9	+1.1	100	12 33.2	−1.6	+2.1	224

METEORS AND METEORITES

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

While the year 1948 did not furnish any meteor shower of special richness, indeed the better annual showers were below average, yet the amount of work done by members of the American Meteor Society was large. What is of more importance, several persons observed on enough nights to record over 500 meteors each. These are Prof. Mohd. A. R. Khan and Tommy Scott, already well-known in the A.M.S., and P. Barnes and J. H. Knowles who are new members. Several others observed between 100 and 400 each. The following table gives more detailed data. The reports for 1948 also will have a very high percentage of plotted meteors, particularly by our best observers. This means that the year's work will be proportionally more valuable.

It cannot be emphasized too often that, while we are very glad to receive reports be they few or many during a given year, yet those persons who have both energy and opportunity to observe often naturally obtain results of far the greatest value. Accurate meteor observing requires skill only to be attained through practice, though some learn faster than others. Also people who try to observe in cities have a great handicap: a clear, moonless sky, without nearby artificial illumination is required for the best results.

Reprint No. 68, containing Meteor Notes for 1947 was distributed last spring. Reprint No. 69, containing the writer's later work on long-enduring meteor trains, was also distributed. Active members of the A.M.S., who had paid their 1948 dues, should have received copies of both. Reprint No. 75, containing Meteor Notes for 1948, will be sent to those who have paid their 1949 dues, which incidentally should have been remitted by this time. If they have not been, please do so at once.

The observations of P. Barnes are particularly valuable as they were made in Pakistan. They will be most useful in helping us widen our knowledge of meteoric phenomena in India which, so far, was almost wholly dependent on Prof. Khan's work. We have also received full reports again from K. Komaki in Japan. He has further sent me a résumé of work done by Japanese observers on meteors in 1947. In all, 26 persons observed 4746 meteors, of which 3198 were separately recorded (presumably plotted in most cases) and 1548 others counted. The Japanese meteor observers deserve great credit for such a good showing when one remembers the serious handicaps they have had to live under, as an aftermath of war. Kuroki sends me maps as well as records for his work in 1948, and a detailed résumé of his work in 1946 and 1947.

For many years past C. F. Fernald of Wilton, Me., has led all others by far in the number of his telescopic meteor observations. We are glad to receive again an extensive list for 1948 from L. C. Peltier. The writer in vain appeals to most members of the A.A.V.S.O. and others to record what telescopic meteors they see and let him have the results. With a few honorable exceptions these appeals bring little or no response. However, as over 3200 observations of telescopic meteors, made in the last 21 years, have been gathered from all sources and are available here, the writer is now engaged in preparing a paper in which these observations will be discussed and various conclusions drawn. It is hoped that the latter will fully justify the time and trouble observers have used in making and reporting these observations to me.

With regard to fireballs, our regional director for the Northwest, Professor J. Hugh Pruett, has continued his eminently successful work in gathering and reducing data on such objects. He has recently worked up and published several paths. The great fireball which appeared over Alabama-Tennessee on 1948 June 7 at 8:05 P.M., C.S.T., thanks to Science Service particularly, had scores of observations reported to me and last summer I made a preliminary solution of its path. It should have been finished long ago but for the inexplicable refusal of two men, in whose hands I had reason to believe a few key observations might be, to answer my letters requesting information. In the 38 years of the A.M.S., I believe that this is the first time such a request has been ignored. The past year was noteworthy also in that on February 18 at about 5 P.M., the largest meteorite ever seen to fall and be recovered came to the ground near the Kansas-Nebraska line. And further, in the northwestern part of Australia what is prob-

ably a meteor crater, second in size only to that in Arizona, finally attracted scientific attention.

We are under great obligations, as usual, to the Hydrographic Office, U. S. Navy, for publishing reports on meteors from ships and for always encouraging ships' officers to make such observations. Also to the U. S. Weather Bureau, various directors of observatories, and of planetariums, the daily press, some radio stations, and many hundred individuals who have sent in reports on meteors and fireballs.

Observation of meteors by instrumental means, using photography and radar, are being pushed with great success, with government aid, by Harvard Observatory and by Dominion Observatory in Canada. Please remember, however, there is still a wide field open for important work, such as the A.M.S. has been carrying out. But we need many more observers who will work often enough to become well trained and to follow some regular program. All such persons can be well assured that their work will really aid in advancing our knowledge of meteors and, through them, in solving other problems as to the evolution and structure of the Solar System. Any person, really interested in the subject of meteors, is cordially invited to write me with a view to joining the A.M.S. and taking an active part therein.

Observer and Station	No. of Nights	No. of Meteors	
Anyzeski, V., East Haven, Conn.	12	179	P
Beetle, Mrs. D. E. Laramie, Wyo.	1	21	P
Brannen, Mrs. D. C., Buhl, Idaho	1	40	C
Braswell, D., Wilson, N. C.	6	159	D
Barnes, P., Lyallpur, Pakistan	72	857	PD
Burlinson, M. A., Tucson, Ariz.	1	22	C*
Burns, H. A., Spring Valley, N. Y.	8	89	P
Bybee, G. F., Columbia, Ky.	12	115	PC
Chabot, H. L., Bronx, N. Y.	5	69	P
Christensen, D., Cranberry Isle, Me.	1	50	C*
Couch, Mrs. D., Kerrsville, Texas	1	22	C
de Kort, W., near Antwerp, Belgium	12	91	P
des Roches, J. B., Kerrsville, Texas	1	21	C*
Dole, R. M., Cape Elizabeth, Me.	14	179	P
Dupee, Mrs. D. S., Barnstead, N. H.	4	69	D
Eason, F. B., Wilson, N. C.	9	256	P
Eason, Mrs. G. B., Wilson, N. C.	5	41	D
Fein, L., Central Park, N. Y. C., N. Y.	1	33	P
Field, R., Greenville, S. C.	3	47	P
Fitzsimmons, C. S., Sibley, Iowa	6	112	C
Gorson, R., Milton, Pa.	1	87	P*
Graham, J. L., Salem, Ore.	1	53	C
Graves, Mrs. P. E., Saco, Me.	3	41	C
Green, G., Pittsfield, Mass.	2	33	P
Griffith, Miss J., Sarasota, Fla.	1	28	P
Griswold, D. E., Scotch Plains, N. J.	4	75	D
Hay, A. A., Chicago, Ill.	3	38	PC
Hyde, Mrs. F. R., Pierre, S. D.	1	83	C*
Jarrell, Miss V., Waco, Texas	1	83	C*
Jensen, Miss A. K., Silverton, Ore.	5	185	C
Johnson, L. T., Blossom Point, Md.	2	24	P
Joliet Ast. Soc., Joliet, Ill.	2	91	C*
Kemper, Father, Kerrsville, Texas	3	36	D
Kennedy, Miss M. C., Saratoga Springs, N. Y.	1	23	C
Khan, Prof. Mohd. A. R., Begumpet, India	58	564	P
Knowles, J., Marblehead, Mass.	30	859	P
Komaki, K., Kanaya, Japan	58	58	P

Observer and Station	No. of Nights	No. of Meteors	
Lee, R., New York, N. Y.	4	50	P
Liston, M., Schenectady, N. Y.	1	45	P
Meade, Los Angeles, Calif.	1	76	C
Milwaukee Astr. Soc., Milwaukee, Wis.	3	463	PC*
Naylor, C. D., Norristown, Pa.	2	30	P
Newman, E. J., Yakima, Wash.	1	43	C
Portras, E., Marblehead, Mass.	2	53	D
Posten, H., New Britain, Conn.	3	70	P
Richardson, T., Ardmore, Okla.	10	179	P
Robinson, N., Melrose Park, Pa.	2	32	C
Sandmeyer, Miss E., Buhl, Idaho	2	67	C
Scott, T., Nauvoo, Ala.	40	819	P
Scott, H. T., Nauvoo, Ala.	2	43	D
Seagraves, D., Apex, N. C.	4	61	P
Siekman, W. J., Jr., Batavia, Ill.	2	185	P
Silvernail, C. J., Gabriel Mts., Calif.	1	122	CP
Skinner, G. B., South Easton, Mass.	2	27	D
Smith College Obs., Northampton, Mass.	1	30	C*
Swihart, T., Elkhart, Ind.	1	23	P
Texas Observers, Waco, Texas	2	451	C*
Thompson, Mrs. F., Eugene, Ore.	2	45	C
Tifft, W. G., Seymour, Conn.	4	59	C
Turnbull, S., Seal Harbor, Me.	2	35	D
Upton, E. K. L., Marblehead, Mass.	2	77	D
Veal, H. K., Ratliff, Okla.	9	187	P
Waldmann, E. G., Bronx, N. Y.	1	44	P
Weitzenhoffer, K., Bronx, N. Y.	6	64	D
Whipple, Wm., Marblehead, Mass.	4	151	D
Widner, R., Portland, Ore.	3	87	D
Worley, C. E., Ottumwa, Iowa	19	377	P
Wright, M. G., Kokomo, Ind.	2	108	PC
Observers reporting less than 20 each: Casual (16 observers)			
Fireballs: (Several hundred observers)		170	
Telescopic Meteors:			
Fernald, C. F., Wilton, Maine		71	
Peltier, L. C., Delphos, Ohio		21	
Tifft, W. G., Seymour, Conn.		6	
4 others		6	
Total Telescopic		104	
Observations for 1946 and 1947:			
de Kort, W., near Antwerp, Belgium		262	CP
Komaki, K., Kanaya, Japan		564	DC
		826	
Total		10207	

Notes: In the last column P denotes that the meteors were plotted, D that they were described singly, C that timed counts of the numbers seen were made. An asterisk (*) denotes that two or more persons took part in the observations. Under "No. of Nights" we count only those on which, as a rule, a minimum of one hour's continuous observations were made. In most cases, the observers watched a considerably longer time, often several hours.

Errata: *P. A.*, LVI, 547, 1948. Last line of Seagraves, D., observations $8^m\ 12^s$, read: 8 12 15:00 17:00 120 19 ? 10 1 P.

Flower Observatory, Upper Darby, Pa., 1949 February 10.

Contributions of The Meteoritical Society

(Known Formerly as The Society for Research on Meteorites)

Edited by FREDERICK C. LEONARD
Department of Astronomy, University of California, Los Angeles 24

A Possible Meteorite Crater in Northeastern New Mexico

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ABSTRACT

This note presents a brief description of a possible meteorite crater found in northeastern New Mexico, in December, 1948, during an air search for another meteoritic fall.

On 1948 December 19, while personnel of the New Mexico Wing of the Civil Air Patrol were flying a search mission for traces of meteorites that fell during the spectacular meteoric display of 1948 December 5, Major Charles L. Phillips, U.S.A.F., discovered an interesting circular crater, centrally located on a high mesa in northeastern New Mexico. Major Phillips, who has already rendered signal service to meteoritics in connection with the location and recovery of the record-breaking achondritic fall of 1948 February 18, in Furnas County, Nebraska, and Norton County, Kansas (C.N. = 1000,400), not only flew Sergeant Frank Hensley of the Kirtland Air Base in at low level, in order to secure the photograph of the crater that accompanies this note (Fig. 1), but later made a hazardous landing in an "L-4" plane near the crater, and returned to Albuquerque with measures of its dimensions and with specimens (some of them giving a faint sulfurous odor), picked up in and around the saucer-shaped depression.

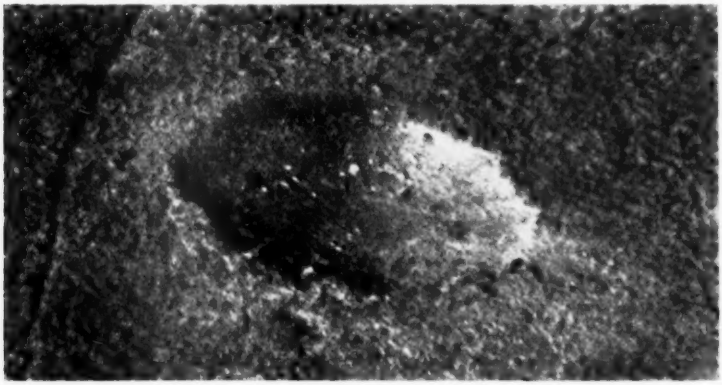

FIG. 1

AN AERIAL PHOTOGRAPH OF A POSSIBLE METEORITE CRATER FOUND IN NORTHEASTERN NEW MEXICO IN DECEMBER, 1948

(N., 10° E. is at the top of the photograph.)

According to Major Phillips, the crater, which is definitely not a sinkhole, is very nearly circular, with a diameter of approximately 30 feet and a depth of 3 feet. The corresponding diameter-to-depth ratio of 10 is exactly that found for one of the smaller craters at Henbury, Australia, and differs but little from the ratios found for a number of other recognized meteorite craters, including those in Estonia and at Wabar, Arabia. A low, but well-defined rim partially encompasses the crater, and large, angular rock-fragments, some of which are visible in the photograph, project, at the same level, from the lower part of the inner slope of the basin in a manner reminiscent of the Odessa, Texas, crater, as is also the lightish discoloration, roughly concentric with the crater, which is fairly well shown in the photograph, except along the northeastern quadrant of the rim, where heavier desert growth conceals it.

None of the specimens picked up at the crater by Major Phillips is meteoritic, but almost all of them are typical of the sort of sharp-edged, angular fragments one would expect to find at an explosion crater of recent origin. In Major Phillips' opinion, the crater is less than 20 years old, because its inner slopes are as yet incompletely covered by vegetation. If so, it is conceivable that the crater represents the point of impact of the main mass of the friable Pasamonte Ranch, Union County, New Mexico, fall of 1933 March 24 (C.N. = 1038,362; cl. = howardite), altho the location of the crater is much farther south and west than might have been expected on the basis of the actual recoveries so far reported from that fall.

Inclement weather has so far rendered impossible any ground search for the crater, which is located at an altitude of more than 7000 feet, in an uninhabited and almost inaccessible region, even the nearest dirt road being many miles from the crater. (The sinuous trail shown to the left (or west) of the crater in the photograph is a path deeply worn in the mesa by the feet of countless range cattle.)

On Naming New Subclasses of Meteorites

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ABSTRACT

It is proposed that any subclass of meteorite that may in future be required be named for the *fall* that proves to be the archetype of the subclass; *e.g.*, if the Norton County, Kansas-Furnas County, Nebraska (1000,400), fall of 1948 February 18 be found to represent a new subclass, this would well be termed *nortonite*, with the symbol A_{400}.

In Table 2 of my paper on "A Simplified Classification of Meteorites and its Symbolism,"[1] 29 distinct subclasses of meteorites are recognized, this number being less than 40% of the number of subclasses (76) separately enumerated in the Rose-Tschermak-Brezina system of meteoritic classification as presented, *e.g.*, on pp. 198-203 of O. C. Farrington's *Meteorites* (1915). Even tho every effort be made to hold the number of subclasses to the minimum, and thus to keep the classification of meteorites as simple as possible, inevitably, as meteoritical knowledge advances, new subclasses will occasionally be required and so will have to be incorporated into the classification. The purpose of this note is to make a recommendation concerning the naming of any future subclasses.

Fortunately, many meteoritic subclasses are named for the first fall that, in each case, was discovered to be representative of the subclass in question and that accordingly called for its creation; but some subclasses, unhappily and inconsistently, are named for people *&c.*, rather than for falls—*e.g.*, "amphoterite," "chladnite," "eukrite," "grahamite," "howardite," "pallasite," and "siderophyre."

It is proposed that any subclass of meteorite that may in future be necessitated be named for the *fall*[2] that proves to be the prototype of the subclass;[3] *e.g.*, if the Norton County, Kansas-Furnas County, Nebraska (1000,400), fall of 1948 February 18 be found to typify a new subclass,[4] this would well be termed *nortonite*, and carry the 3-letter subclass symbol A_2no, since the Norton-Furnas fall belongs to the *class* of calcium-poor or ferriferous achondrites (A_2).[5]

References and Notes

[1] *C.M.S.*, **4**, 141-6; *P. A.*, **56**, 437-42, 1948.

[2] The *primary* part of the name of the fall, to which is appended the suffix *-ite*, should, of course, be employed for this purpose; *e.g.*, "cumberlandite" (*not* "whitleyite") should be used for the subclass of which the Cumberland Falls, Whitley County, Kentucky (844,368), fall of 1919 April 9 is to date the only known example.

[3] The reason for this proposal is that a place name is indicative of the origin of a subclass, whereas a personal name is usually not suggestive of anything pertaining to it. In my opinion, personal names should, as a rule, be avoided in science, since they are at best of only historical significance.

[4] As it probably will; *cf.* the introduction to the valuable paper on the mineralogy of the Norton-Furnas fall, by Carl W. Beck & Lincoln LaPaz, in *C.M.S.*, *P. A.*, **57**, 85-8, Feb., 1949.

[5] Regarding this symbolism, *v.* the paper cited in ref. (1), *ante*.

Is the Crater of Wolf Creek, Western Australia (—1278,193), Meteoritic?

Mr. J. Fraser Paterson, Box 151*a*, Broken Hill, New South Wales, Australia, has kindly sent us a copy of the *Australian Geographical Magazine, Walkabout*, **14**, No. 13, Nov. 1, 1948, which, on pp. 10-16, contains an interesting and liberally illustrated article by Charles H. Holmes, the Managing Editor, on "The Hidden Crater of Wolf Creek." The following excerpts are taken from the opening part of that article:

"This is the story of a hole on the northeastern fringe of the Desert Basin, an artesian region larger than the State of Victoria, which extends southward from foothills of the ranges that pattern the Kimberleys division of Western Australia until it merges with the Great Sandy Desert, several hundred miles to the south. The precise location is 64 miles south of Hall's Creek, and 400 miles inland, almost due east of Broome (Longitude 127° 46′ [east], Latitude 19° 18′ south). [The 9-digit coördinate number = —12777,1930.]

"It is a hole of rather tremendous proportions, estimated to be over half a mile wide, 100 feet deep below plain level, with a rocky rim which in places rises to 100 feet above the level of the surrounding desert.

"Passing nearby over the spinifex-spattered wastes, you would never know the crater existed. From plain level there is just a low ridge. Perhaps the desert nomads in their wanderings in earlier years knew of it, as they chased their quarry over its rim. Maybe on occasions too they found water in the bottom of the crater, as, altho it is now bone-dry, there is evidence that water has accumulated there on occasions.

"There was no urge for any cattlemen from distant leases to climb what was

seemingly a sterile stony ridge. No cattle would be there. And so the crater existed rather secretly, its façade a stony outcrop. If cattlemen from leases on better country as close as Sturt Creek (25 miles) and Billiluna (30 miles) knew of its existence, they apparently attached little importance to it, and there is no record available to indicate that anyone ever reported its existence in earlier years.

"On 21st June, 1947, when flying over the Desert Basin south of Hall's Creek, where they had been making a reconnaissance in a Zinc Corporation plane in the search for oil, on behalf of the Bonaparte Gulf Company Pty. Ltd., Dr. Frank Reeves, geologist, and Mr. N. B. Sauve, geophysicist, both of the Vacuum Oil Company, were intrigued to see below them a perfectly shaped crater of huge dimensions. With its basin half shadowed, it was an arresting blob on a featureless landscape.

"The crater was not marked on the map as such, but there is a mark for a hill more or less in the exact location of the crater. South of the crater, some 12 miles distant, is the little-used Canning Stock Route. Over this stock route, that stretches down the map to the Wiluna railhead, some 700 miles distant, only a few hundred head of cattle now travel each year.

"The geologists wondered whether the crater was of volcanic origin or whether it had been caused by a meteorite. As a fact, it resembled in contour the great Meteorite Crater near Canyon Diablo in the Arizona Desert. . . .

"On 24th August, 1947, subsequent to their locating the crater several months earlier, Dr. Reeves decided to visit it by traveling overland with assistant-geologist H. J. Evans and Dudley Hart, who piloted the Zinc Corporation plane from which the crater had been first sighted. The trip was made by jeep from Billiluna Station, astride the Canning Stock Route to the south. It is possible to reach the crater also from Hall's Creek, or by landing a small plane at Sturt's Creek Station, 25 miles east, and going by truck or on horseback across the desert.

"First impressions favored the volcanic theory, as it was hard to believe that a meteorite-blast could tilt the strata so regularly. On the other hand, it is situated on a flat plain, and there is no evidence of a cone, which is usually formed by a volcano; also, there was the absence of volcanic or igneous rocks.

"Following a discussion with Dr. H. G. Raggatt, Director of the Commonwealth Bureau of Mineral Resources, Dr. Reeves is now convinced that it is an immense meteorite crater. Dr. Raggatt and his associates were impressed with the crater's resemblance to the Arizona crater.

"Dr. Reeves estimates the crater to be 2,800 feet in diameter at its bottom. He writes: 'The rimrock is 60 to 100 feet above the adjacent desert, which rises gently towards the crater and shows occasional exposures of sandstone bedrock. The walls of the crater are steep and composed of hard micaceous sandstone, probably pre-Cambrian. This sandstone is shattered and tilted at various angles outward from the crater. The rimrock of the crater consists of sandstone talus partly drifted over by wind-blown sand. Trees of considerable size grow in the bottom of the crater, around a claypan in which there are sinkholes exposing calcareous tufa. No meteorite fragments were found in the vicinity, but only about 2 hours were spent in the locality. The fact that the crater lies in a region not crossed by scheduled plane flights and not visited by prospectors and station riders is responsible for its not being earlier discovered. Old-timers in the region had no knowledge of it.'

"It is believed by the geologists who have visited the crater that it ante-

dates the coming of the white man to Australia—perhaps it was formed 300 years ago. The estimate of age is based on various factors, such as the extent to which the lip of the crater was worn down in places and the soil that was filling up the crater, which had undoubtedly been much deeper when first formed. Another factor is the size of the dead trees in the crater, some of which were 2 feet thick. It is understood their theory is that the meteorite may have penetrated the earth some 600 feet, and then exploded. No meteorite iron was found in the vicinity, altho there was insufficient time to make anything like a search."

The article continues under the subheadings, "Is There Another Crater?," "[The Australian Geographical] Society's Party Visits Crater," and "Scientific Examination." Lack of space precludes further extracts, however. Several of the photographs accompanying the article bear a striking resemblance to similar views of the Canyon Diablo, Arizona, Crater, even tho the Wolf Creek Crater appears to be situated in a region of considerably less sparse vegetation. If meteoritic material is discovered in the neighborhood of the Wolf Creek Crater, and it is thereby proved to be of meteoritic origin, it will rank, next to the Canyon Diablo Crater, as the second largest known meteoritic crater of the world.—F.C.L.

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Secretary of the Society: OSCAR E. MONNIG, 1010 Morningside Drive, Fort Worth 3, Texas

Comet Notes

By G. VAN BIESBROECK

No new comets have been announced so far in 1949. Of those that were found last year several remain under observation but they are all faint. COMETS MRKOS (1948 *a*) and ASHBROOK-JACKSON (1948 *i*) will soon be lost in the evening sky. COMET PAJDUSAKOVA-MRKOS (1948 *d*) was reduced to a small coma of 14th magnitude when last recorded here on January 18. COMET 1948 *l* which was so startling bright for southern observers last fall was down to 10th magnitude at the end of January. The tail was hardly visible any more but the coma showed a well-defined nucleus. The drop in brightness is expected to continue rapidly.

Little is to be added concerning the other faint comets enumerated last month. It is not improbable that COMET SCHWASSMANN-WACHMANN No. 1 (1925 II) has gone through another outburst of light during the January full moon. In the beginning of the month (January 7, 8) the magnitude was down to 18. On January 30 it had risen to 15.5 and remained around 16 on February 2. While at the earlier date it appeared as a very diffuse little round spot, at the turn of the month there was a well-condensed nucleus with a tail-like extension. No comet has ever shown as great changes in brightness and appearance without appreciable change in the distance from the sun. It should be carefully watched.

The 1949 *Handbook of the British Astronomical Association* gives ephemerides for five expected returns of periodic comets this year. They are Comet Neujmin 2 (1916 II), period 5.45 years. Last seen 1927. Comet Gale (1927 VI), period 10.82 years. Last seen 1938. Comet Väisälä (1939 IV), period 10.52 years. Last seen 1939. Comet Du Toit (1945 *c*), period 4.5 years. Last seen 1945. Comet Reinmuth 1 (1928 I), period 7.69 years. Last seen 1935. They all remain faint.

The least so is Comet Gale which should now be looked for in the morning sky according to the following ephemeris computed by Dinwoodie:

1949		α h m	δ ° ′	m
March	1	17 50.0	−18 53	13.9
	9	18 25.1	19 56	13.5
	17	19 2.4	20 39	13.1
	25	19 41.3	20 55	12.9
April	2	20 20.9	20 42	12.6
	10	21 0.2	20 00	12.3
	18	21 38.2	18 52	12.3
	26	22 14.3	17 23	12.3
May	4	22 47.8	−15 41	12.4

This is the second return of this comet since its discovery in 1927.

Williams Bay, Wisconsin, 1949 February 11.

VARIABLE STARS

Variable Star Notes from the American Association of Variable Star Observers

By LEON CAMPBELL, Recorder

SS Cygni in 1948: This ever popular variable passed through a period of marked irregularity during the past year. Besides the appearance of 4 A-type maxima there are 3 of the C-type, as well as several outbursts of lesser intensity.

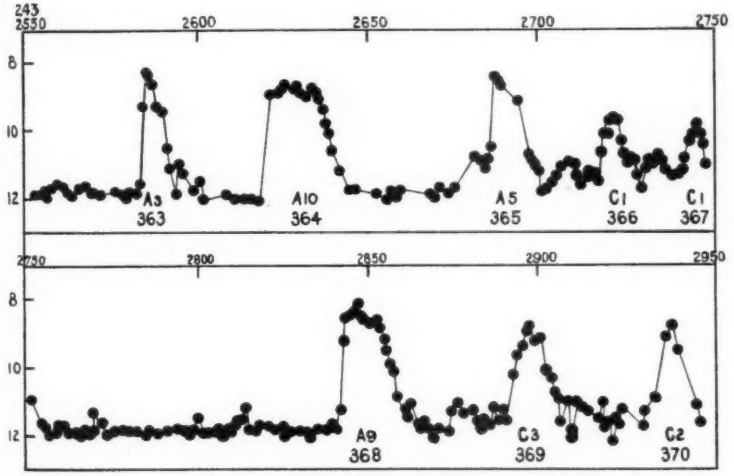

FIGURE 1
SS CYGNI, DAILY MEANS IN 1948

Table I contains the daily means in the same form as published in these columns in previous years. A total of 1,261 observations were obtained on 300 nights of the year.

TABLE I

DAILY MEANS

213843 SS CYGNI J.D. 2432550-2920

243	—0—	—1—	—2—	—3—	—4—	—5—	—6—	—7—	—8—	—9—
2550	5 11.96	4 11.92	3 11.93	3 11.90	2 11.80	1 12.0	1 11.7	.....	5 11.60	4 11.68
60	1 11.7	3 11.87	3 11.97	1 11.9	3 11.77	4 11.78	4 11.65	1 11.6	2 11.90	4 11.85
70	1 11.9	2 11.90	.....	.....	.....	1 11.8	.....	2 11.90	2 12.00	2 11.80
80	3 11.83	2 11.85	3 11.57	7 9.26	3 8.33	1 8.4	2 8.65	2 9.30	3 9.37	1 9.5
90	2 10.50	1 11.1	2 11.15	1 11.9	1 11.0	1 11.3	.....	.....	1 11.8	1 11.8
2600	1 11.5	1 12.0	.....	.....	.....	.....	.....	.....	1 11.9	1 12.0
10	1 12.0	.....	.....	1 12.0	1 12.0	1 12.0	2 12.00	2 12.05	.....	.....
20	.....	2 8.95	.....	1 8.9	1 8.8	2 8.70	.....	.....	1 8.8	3 8.70
30	1 8.9	1 9.0	.....	1 8.8	1 8.9	2 9.05	1 9.4	1 9.8	2 10.05	1 10.6
40	1 10.8	1 11.2	.....	.....	1 11.8	.....	1 11.8	.....	.....	.....
50	.....	.....	1 11.9	.....	.....	1 12.0	1 11.8	.....	1 12.02	2 11.80
60	.....	.....	.....	.....	1 10.9	.....	.....	1 10.9	1 11.9	1 12.0
70	1 11.9	1 11.7	.....	3 11.90	.....	1 11.7	.....	.....	.....	.....
80	.....	1 10.8	1 10.9	1 10.9	1 11.1	1 10.8	1 10.5	5 8.46	1 8.6	3 8.70
90	.....	.....	.....	.....	1 9.1	.....	.....	2 10.70	1 10.9	2 11.00
2700	4 11.22	1 11.8	1 11.7	3 11.60	2 11.55	2 11.40	2 11.05	.....	8 11.01	2 10.95
10	3 11.00	2 11.35	2 11.60	2 11.45	1 11.4	2 11.20	4 11.25	1 11.5	2 10.65	4 10.12
20	1 10.0	4 9.68	3 9.67	3 9.73	3 10.30	3 10.67	1 10.9	1 10.8	3 10.87	3 11.37
30	1 11.7	4 11.02	8 10.85	7 10.94	4 10.82	10 10.77	4 10.90	5 11.16	3 11.13	3 11.30
40	8 11.22	11 11.32	10 11.19	4 10.80	2 10.30	4 10.15	1 9.8	3 10.37	2 10.45	4 11.00
50	2 10.95	.....	.....	1 11.7	2 11.80	2 12.00	6 12.02	11 11.93	7 11.76	5 11.82
60	7 11.76	9 11.94	1 11.9	4 11.95	7 12.00	6 11.97	3 11.87	2 12.00	3 11.33	5 11.88
70	4 11.92	5 11.68	7 11.94	7 12.06	7 11.91	2 11.95	3 11.93	5 11.88	4 11.95	5 11.90
80	2 11.85	1 11.9	4 11.82	3 11.97	2 12.00	7 11.91	2 11.95	6 11.97	6 11.95	5 11.96
90	7 11.91	8 11.95	9 11.89	7 11.86	7 11.86	12 11.88	7 11.86	2 11.95	11 11.89	4 11.50
2800	6 11.90	4 11.95	6 11.97	8 11.91	6 11.92	5 11.84	5 11.96	5 11.82	6 11.82	9 11.86
10	6 11.75	5 11.56	3 11.57	1 11.2	4 11.88	.....	2 11.90	6 11.77	4 11.80	5 11.76
20	12 11.78	9 11.84	7 11.87	5 11.90	3 11.80	1 12.0	5 11.88	4 11.90	10 11.93	3 11.93
30	4 11.98	6 11.95	4 12.02	5 11.90	9 11.85	4 11.95	.....	2 11.85	5 11.76	1 12.0
40	7 11.81	3 11.23	1 9.2	7 8.60	8 8.46	11 8.35	7 8.19	7 8.47	1 8.6	5 8.52
50	7 8.69	18 8.73	11 8.65	7 8.86	10 9.15	9 9.51	5 9.90	3 10.03	3 10.87	.....
60	2 11.20	1 11.5	4 11.08	12 11.74	2 11.65	1 11.8	1 11.6	3 11.80	1 12.0	.....
70	1 11.8	.....	.....	2 11.90	3 11.37	.....	2 11.10	6 11.40	.....	.....
80	6 11.25	5 11.54	1 11.8	10 11.60	3 11.60	5 11.66	4 11.18	8 11.50	1 11.6	4 11.22
90	1 11.6	1 11.5	6 10.20	3 9.60	5 9.64	1 9.4	3 8.90	2 8.80	1 9.2	5 9.14
2900	.....	.....	.....	2 10.30	2 10.75	3 10.97	1 11.6	2 11.60	1 11.0	2 12.00
10	1 11.0	3 11.20	4 11.13	4 11.32	2 11.30	.....	.....	1 11.5	1 11.0	3 11.77

The mean cycle for the 1948 maxima is 52 days, as compared with a mean value of 51.6 days derived from the 369 maxima observed during the 52 years since its discovery. The light curve for 400 days, J.D. 2432550 to 2950, is illustrated in Figure 1.

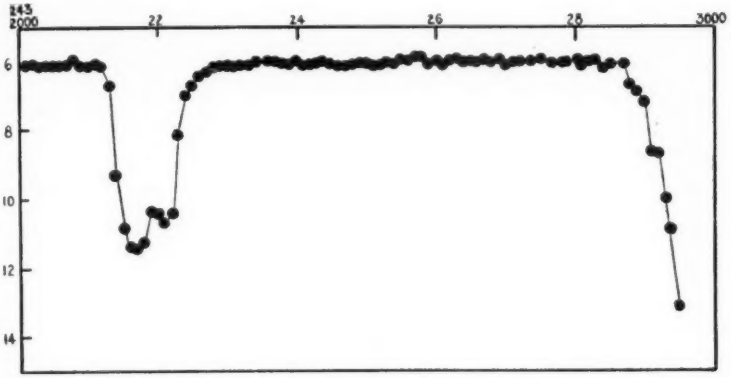

FIGURE 2
R CORONAE BOREALIS, 1947-1948

R Coronae Borealis: This erratic variable, which began to show signs of fading last December, has finally, after several halts on its decrease, reached the 13th magnitude. Its light curve from June, 1946, to date is shown in Figure 2.

TABLE II
OBSERVED MAXIMA

No. Max.	Type	J.D. 10.0 I	Diff.	J.D. Max.	Diff.	J.D. 10.0 D	Diff.	Max. Max.
363	A3	2432583	61	2432585	57	2432589	52	8.3
364	A10	2620	37	2628	43	2638	49	8.7
365	A5	2686	66	2690	62	2695	57	8.5
366	C1	2720	34	2722	32	2724	29	9.7
367	C1	2745	25	2746	24	2747	23	9.8
368	A9	2842	97	2848	102	2856	109	8.4
369	C3	2892	50	2897	49	2903	47	8.8

Observations received during January: A total of 3,916 estimates was received in January from 53 observers as follows:

Observer	No. Var.	No. Ests.	Observer	No. Var.	No. Ests.
Ahnert, P.	48	392	Dillon	1	2
Bicknell	10	28	Edelenyi	1	1
Bogard	53	107	Escalante	160	446
Bufkin	2	4	Estremadoyro, V. A.	3	7
Cain	3	3	Fernald	330	629
Caraioryis	6	6	Greenley	54	103
Chandra	155	200	Hardi	1	1
Cilley	21	50	Hartmann	159	177
Cragg	19	21	Herring	7	10
Daley	8	10	Howarth	16	16
Darling	10	16	Kantor	1	1
Darnell	3	11	Kardashian	3	3

Observer	No. Var.	No. Ests.	Observer	No. Var.	No. Ests.
Kirchhoff	27	50	Renner	74	74
de Kock	113	433	Romano	6	173
Lacchini	46	112	Rosebrugh	19	57
Lankford	4	4	Rusho	3	6
Lowder	6	9	Seagroves	8	8
Luft	6	22	Taboada	84	84
Miller	6	6	Tarbell	13	38
Nadeau	32	39	Tifft	20	20
Oravec	40	80	Tsuneoka	5	6
Parks	21	21	Venter	13	19
Pearcy	103	109	Wilmot	3	3
Peltier	154	187	Yamada	8	20
Penhallow	28	51	Zonis	2	2
Pearson	31	31	—		
Rakosi	1	6	53	totals	3,916
Reeves	1	2			

February 15, 1949.

General Notes

Sir Harold Spencer Jones, Astronomer Royal of England and Director of the Greenwich Observatory, is spending a month in Southern California. He is scheduled to give a number of addresses while there. Some of the topics which he will discuss are, "The Determination of Precise Time," "Measuring the Sun's Distance," "The Earth as a Clock," "The Origin of the Solar System," "Is there Life on Other Worlds?", and "The Age of the Stars."

Dr. F. R. Moulton retired as administrative secretary at the close of his term, January 15. His great services to American science through AAAS activities will be the subject of a later article in *Science*. As announced in the issue of November 26, 1948, Prof. Howard A. Meyerhoff is assuming the position of administrative secretary of AAAS. Until the end of the present academic year, he will also be engaged as professor of geology at Smith College. (*Science*, February 4, 1949.)

Photographic Plates for Scientific and Technical Use.—This is the title of a pamphlet of 44 pages recently issued by the Eastman Kodak Company, Rochester, N. Y. It is the sixth in a series of such pamphlets, the earlier ones having been called Photographic Plates for Use in Spectroscopy and Astronomy. This pamphlet is therefore of immediate interest to astronomers. It is well illustrated with photographs and charts and constitutes a handy reference for determining the particular photographic plate best suited to a given project.

The Rittenhouse Astronomical Society

At a recent meeting of the Rittenhouse Astronomical Society the following staff of officers was elected for 1949:

President	Dr. Raymond H. Wilson, Jr.
Vice-President	Dr. I. M. Levitt
Treasurer	Mr. S. W. Johnson
Secretary	Mr. George Evalt
Members-at-Large	Theodore Bodde
	Sara Lee Lippincott
Membership Chairman	Mr. Harry B. Rumrill
Current Events Chairman	Dr. Charles P. Olivier
Program Chairman	Dr. Peter van de Kamp

Since the Swarthmore Chapter of Sigma Xi extended the Rittenhouse Astronomical Society an invitation to attend the lecture on "The Origin of the Solar System" by Sir Harold Spencer Jones, on February 9, the Society decided to dispense with a formal meeting in February. Some forty members attended the Sigma Xi dinner in honor of the Astronomer Royal, and the many more who came to Swarthmore later for the lecture were rewarded by the excellent talk dealing with the various theories which attempt to explain the solar system.

As is customary, the March meeting will be held jointly with the Franklin Institute. Dr. G. Van Biesbroeck will speak on "Comets."

SARAH LEE LIPPINCOTT, *Secretary, Pro Tem.*

British Astronomical Association

This association generally referred to as the B.A.A. had its beginning in the fall of 1890. It, therefore, became fifty years of age in 1940, but conditions were unfavorable for a proper commemoration of the event at that time. In 1942 the Council of the B.A.A. accepted an invitation from the Royal Astronomical Society to share its premises at Burlington House. At the first meeting of the B.A.A. at Burlington House, the President offered the suggestion that the time was opportune for the preparation and publication of a short history of the first fifty years of the Association.

The suggestion was readily accepted and steps taken at once for carrying it out. The result is a 130-page paper-bound booklet in the Memoirs of the British Astronomical Association bearing the title "The History of the British Astronomical Association (the first fifty years)," forming Part 2, Volume 36 of the Memoirs, and dated December, 1948.

The booklet is divided into two parts, the first a general, chronological listing of events, in ten chapers. The second, a detail of each of the six Branches, and of each of the nineteen Sections. The last two pages contain lists of the several officers from the beginning, and a chart showing the fluctuation in membership up to 1945. The membership was higher in 1945 than at any previous time, having risen at that time to 1400.

A reading of this history of the B.A.A. will at the same time be a reading of the history of London through two wars and also a history of the noteworthy events in astronomy during this period. The B.A.A. is to be congratulated upon its continuous record of the past fifty years and felicitated upon the bright prospects for the fifty years which lie ahead.

Name-List of Variable Stars.—A copy of this new list, which is dated July 20, 1948, has recently been received. It was prepared under the direction of the Commission for Variable Stars of the Astronomical Council of the Academy of Sciences of the USSR and the Sternberg Astronomical Institute. The introduction is printed in Russian and in English. The list contains 266 new variable stars which were without permanent designation before. These stars are arranged in order of right ascension, and the maximum and minimum magnitudes as well as their preliminary designations are given. Seventeen pages of remarks in English pertaining to the variables are appended. The entire pamphlet consists of 29 pages bound in paper cover.

The Newton Publishing Corporation has recently been established at 114 East 32 Street, New York 16. On January 1, 1949, it became sole agent in the United States for the famous Swiss Publishing House, Verlag Birkhauser, Basle. The books already available represent the latest scientific and technical works, in German, written by the leading scientists in Europe. The list includes indispensable standard works on mathematics, chemistry, biology, physiology, geology, astronomy, engineering, architecture, textiles, and biochemistry. In addition, there are many of the most important scientific periodicals appearing in Europe today, including "Experientia," and "Elemente der Mathematik." These are essential books for every scientific worker and library, and they can be obtained at booksellers or direct from the Newton Publishing Corporation who will send a catalog on request.

Minor Planets for 1949.—A paper-bound book of 108 pages, containing a list of 1199 minor planets which come to opposition in 1949 has recently been published by the Cincinnati Observatory under the auspices of the International Astronomical Union. Ephemerides for these minor planets are given for six dates at eight-day intervals centering about the opposition date, based upon computations made at the Astronomisches Rechen-Institut now located at Heidelberg. The first seven pages give the minor planets serially in order of discovery. This list contains 1564.

Copies of this volume are available for distribution to recognized institutions and to individuals who are actively engaged in asteroid study. Requests for copies with statement as to the purpose for which they are to be used should be addressed to Dr. Paul Herget, The Cincinnati Observatory, Cincinnati 8, Ohio.

Eastern Telescope Makers Association

An organization bearing the name given in the title above has recently been formed in New York City. At present only memberships in New York are solicited. By the beginning of April, associate membership will be open. The major qualification for a candidate for membership is that he be interested in telescope making.

At this time two 10-inch and one 12-inch mirrors are being polished. There are also tentative plans for installing a 21-inch telescope up state. Another group project is the preparation of a book on the Palomar project. Any ATM interested in joining this organization should write to W. R. Cole, Director of Publicity, EASTERN TELESCOPE MAKERS ASSOCIATION, 726 East 10th Street, Brooklyn 30, N. Y.

Provisional Relative Sunspot Numbers

1949 January	Relative Numbers	1949 January	Relative Numbers	1949 January	Relative Numbers
1	80	11	109	21	167
2	95	12	114	22	153
3	82	13	122	23	158
4	88	14	125	24	152
5	70	15	118	25	152
6	87	16	138	26	139
7	91	17	143	27	90
8	94	18	161	28	86
9	106	19	177	29	80
10	118	20	169	30	90
				31	119

Mean for January
R = 119.4

The Green Flash

The description of the phenomenon of the Green Flash published in the January, 1949, issue of POPULAR ASTRONOMY reminded me of the only time so far that I have seen the phenomenon clearly. Although this was about fifteen years ago I remember all detail, partly because I wrote detailed descriptions to several friends immediately afterwards.

I saw the Green Flash in the Baltic Sea, from the passenger motorship Hansestadt Danzig, enroute from Swinemünde to Danzig. It was in June, 1934, the ship must have been close to 17° eastern longitude just out of sight of the coast. The sea was as calm as a mirror and the sky without any trace of cloud, clear down to the horizon. Knowing that these were good conditions for seeing the phenomenon I watched the sun sink below the horizon. I had expected that the Green Flash would appear in the last instant of the sinking; in retrospect I am inclined to say that I had expected the last visible segment of the sun to turn green. When the sun disappeared completely I felt disappointed and was just going to turn around when the "flash" appeared.

Like Mr. Comrie I estimated the time interval between the disappearance of the last portion of the sun's rim and the beginning of the flash at about one second; it may have been slightly more. The "flash" was very bright, a bright grass green in color and lasted for more than a second, one and a half seconds would be about right. It began with fair intensity, grew bright, stayed bright and then disappeared rapidly but not instantaneously. If I were asked to trace the light curve I should draw the end of an ellipse, cut off through its focal point.

Later I experienced standing on shipboard and being passed over by the slowly turning searchlight of a distant warship. Except for the difference in color the two sensations were exactly alike.

I should like to add a sentence about an interesting report I have read. The reporter was in the Swiss Alps, walking along a path which paralleled a sloping mountain ridge behind which the sun was setting. He saw the Green Flash develop and by adjusting the speed of his walk succeeded in seeing it for a duration of more than one minute.

WILLY LEY.

Pine Manor, Montvale, N. J.

Annual Meeting of the Duodecimal Society of America

A feature of the annual meeting of the Duodecimal Society of America, recently held in New York City, was the explanation of a new, mathematically-based notation for music by Velizar Godjevatz. Mr. Godjevatz, who has studied music at Oxford, Grenoble, and in Berlin, pointed out the illogic of applying to our present 12-tone tempered system the staff of five lines and the concepts of the octave and a 7-tone system.

"It should be borne in mind," he said, "that our present musical notation was conceived for another musical system in use centuries ago. When Werckmeister definitely established our 12-tone equidistant system, and Bach drew the necessary conclusions in publishing his Well Tempered Clavichord in 1722, the notation was not changed to accommodate the practical results obtained by embracing this new system."

He proposed the "Notation Godjevatz" in which each of the twelve tones within a Region (his term for the sound range of an octave) has separate representation on a staff of seven lines, with the middle line eliminated for easier scanning except when a note falls upon it. This staff requires neither sharps nor flats, and is proposed as greatly simplifying the learning and the performance of music, both for the amateur and the professional.

Mr. Godjevatz explained the mathematical relationships among musical tones, calling a notation that would make these relationships plain the most important problem in music today. "It would be advisable to employ for our dodecaphonic musical system the duodecimal number system," he declared. "Every tone could be represented by one digit only, and this would be its relative pitch. The adoption of the duodecimal musical notation would create a sort of musical arithmetic. This would encourage more people to learn to play an instrument, people who otherwise would not expend the time and effort required to master a good reading knowledge of music."

Other speakers on the Society's program were Kingsland Camp of New York City who spoke on the development of a duodecimal slide rule, and Frederick S. Condit of Gladstone, New Jersey, who presented a psychological experiment in counting.

The Duodecimal Society is a national organization devoted to research and education of the public in the use of base twelve in numeration and other branches of pure and applied science. Its officers for the new year are George S. Terry of Hingham, Mass., chairman of the Board; F. Emerson Andrews of Tenafly, New Jersey, president; Paul E. Friedemann of Pittsburgh, vice-president; Ralph H. Beard of New York City, secretary; and H. K. Humphrey of Winnetka, Illinois, treasurer.

Exhibit of Scientific Apparatus

An exhibition of 45 pieces of scientific apparatus used at Harvard College in the Colonial period was opened at the University's Mallinckrodt Chemical Laboratory on February 12. Open to the public without charge, the exhibition includes some of this country's earliest scientific equipment that still exists. In all, ten early fields of scientific activity are represented, including astronomy, optics, mechanics, electrostatics, hydrostatics, pneumatics, biology, magnetism, chemistry, and mineralogy. Comprising only a small part of the surviving instruments and scientific collections used at Harvard in the period ending 1837, the

present exhibition is described by science historians as the best collection of 18th century scientific apparatus in the United States.

The material shows that contrary to the statements of some historians, at the beginning of the 19th century, Harvard College gave its students something more than "a fair training in Latin and Greek, a little mathematics, and a touch of theology if they so inclined." Nature of the instruments indicates that they were used both for research and the advancement of knowledge as well as teaching.

None of the items in the collection date back beyond 1764. In that year, Harvard Hall, which housed the College Library and the elegant "philosophical chambers," burned to the ground. All the instruments, as well as the infant school's library then on hand, were destroyed. Within 15 years, however, by gift and purchase, Harvard had assembled a new collection of Philosophical Apparatus even more extensive than the earlier one. Instruments from this collection comprise the present display.

Revealing the development of science during the last two centuries, the exhibition includes telescopes, balances, pullies, lenses, orreries, air-pumps, minerals, and even mounted fish. In the field of astronomy, one of the first sciences taught at Harvard, are several exhibits, including telescopes and orreries. The latter are small-scale planetariums which show the motions of the planets and their satellites. Done in brass and mahogany, one of these orreries is over 6 feet in height and diameter. One of the telescopes, a reflector, was made for Harvard under Benjamin Franklin's supervision and cost 100 guineas. Other astronomical instruments on exhibition are a cometarium and sextant.

Astronomical News Letter No. 37

Readers of astronomical literature during the war will remember that a Committee for the Distribution of Astronomical Literature was formed under the auspices of the American Astronomical Society. Thirty-six Astronomical News Letters were issued by the committee. With the return of more nearly normal intercommunication after the close of the war, the need for the services of such a committee gradually disappeared.

Recently a new need has arisen and the committee with somewhat different personnel has been revised to meet it. Since the latter part of 1947 important astronomical results determined by workers in the Soviet Union have been published exclusively in the Russian language. This new committee, under the chairmanship of Dr. Otto Struve, will translate the essential parts of the Russian publications into English in order that the results may be more widely available. These English versions will take the form of Astronomical News Letters, edited, as before, by Dr. Bart J. Bok, with the assistance of Miss Margaret Olmsted.

The first issue in the new series is called Astronomical News Letter No. 37, and is dated November 9, 1948. It consists of twelve mimeographed sheets containing summaries by Dr. Struve of eight papers by well-known Russian scientists.

Individuals and institutions inside the United States who wish to receive this News Letter regularly can have their names placed on the mailing list for $3.00. The C.D.A.L. will keep track of the cost of production and mailing. They expect not to have to bother you for an extra $3.00 until they shall have delivered at least fifty pages of abstracts. Requests for the letters should be sent to Dr. Bart J. Bok, Harvard Observatory, Cambridge 38, Mass.

Unusual Phenomenon of Jupiter's Satellites

On March 4 from 17:12 until 17:20 G.C.T. the four bright satellites of Jupiter will be simultaneously invisible, satellite I by transit, II by eclipse or occultation, III by eclipse, and IV by occulation. This is a rare event. The last previous occurrence of which I have knowledge was on July 16, 1939. Jupiter will not be visible in the United States at this time because of daylight.

One might suppose it possible by rare chance to have all four satellites eclipsed at once—somewhat as chance brought it about that all of the planets, even including Pluto, were evening stars from June 15 to June 17 last—but this is impossible.

As March 28 marks the 200th anniversary of the birth of Laplace it is well to call to mind his celebrated demonstration that, because of the mutual attractions, the mean longitude of the first satellite, seen from the center of Jupiter, minus three times that of the second satellite, plus twice that of the third satellite, is always equal to two right angles, so that they cannot all be eclipsed at the same time. In such a case the longitudes of necessity would be nearly equal, and the function nearly equal to zero.

To illustrate by the current conditions, satellites II and III are simultaneously in eclipse hence satellite I must be approximately two right angles, that is, 180° away, and so between the Sun and Jupiter, casting its shadow on Jupiter, then or near that time. This is the case.

Samuel G. Barton.

Flower Observatory, Philadelphia 4, Pa.

The Cleveland Astronomical Society

On December 10, 1948, the Cleveland Astronomical Society held its annual Christmas party at the Warner and Swasey Observatory of the Case Institute of Technology. The speaker was Dr. Henry F. Donner of Western Reserve University, who told of his recent remeasures of double stars at the University of Michigan's Lamont-Hussey Observatory in Bloemfontein, Union of South Africa. As he also repeated his historic automobile trip down the African continent, his talk was enlivened by many colored slides. Although this reviewer was unfortunately unable to be present, from all reports it was an enjoyable meeting.

On January 14, 1949, the speaker was Mr. John W. Streeter of the Vassar College Department of Astronomy, who spoke to a crowd of over 100 members and guests on his specialty, "Early American History of Astronomy." He opened his lecture by pointing out that American interest in astronomy is at a high level just now, as evidenced particularly by newspapers and popular magazines. This he attributed in part to the recent activity in such fields as solar astronomy, micro-wave astronomy, rockets, and the Palomar Mountain Observatory. The fine record of astronomers in the war which led to post-war government support of various phases of astronomical research was also mentioned as a factor.

The speaker showed that this interest is a natural outgrowth of the American astronomical tradition, which he traced by means of a number of illustrative anecdotes, many of which dealt with unusual, little-known figures of the early American scientific scene. Thomas Harriot was mentioned as being the first scientific man (and astronomer) to visit America, in 1585, and it was suggested that he had some kind of telescope, some 25 years before the accepted date of its invention. The first "resident" astronomer apparently was Zechariah Brigden of Stonington, Connecticut, who published almanacs (near 1659) which contained a

good deal of astronomy. The first American scientific paper to be reprinted in Europe was given as a description of a comet in 1664, written by Samuel Danforth, who was graduated from Harvard in 1643. It was suggested that the first "amateur astronomer" in America was Sergeant John Sherman, a member of a surveying party in 1652. John Winthrop, Jr., was given credit for including astronomy among his pursuits (as did most cultured gentlemen of the period), although the "discovery" of the fifth satellite of Jupiter, sometimes attributed to him, was in all probability due to a fortuitously placed star, as shown in a recent article by the speaker. Arthur Storer, who observed a comet in 1680 and wrote to Newton from Maryland, was honored by being mentioned by name in the "Principia." Isaac Greenwood's lectures on astronomy and other sciences were very popular in Boston in 1727. The first Hollis Professor of Natural Philosophy at Harvard (1727-1738), he was removed for intemperance. This, according to the speaker, accounts for the fact that no Harvard astronomer has imbibed since that time. The importance of Bowditch was stressed, as also were the contributions of Benjamin Franklin, Maria Mitchell, Benjamin West, and David Rittenhouse. The role played by Ohio in the development of astronomy was illustrated by the founding of an observatory at Hudson in 1838, at Oxford in 1839, and at Cincinnati in 1843, when John Quincy Adams made his famous trip west at the age of 76 to dedicate the observatory. Coming down even more closely to the local scene, the speaker reminded his listeners of the important contributions to telescope-making of the Cleveland firm of Warner and Swasey, and of the significant research and popularization being done by the Case Institute's Observatory which bears their names.

The wide reading and extensive preparation evidenced in the lecture were well appreciated by the attentive audience.

PAUL ANNEAR, *Recording Secretary.*
Baldwin-Wallace College, Berea, Ohio.

Civil Service Examination Announcement

The U. S. Civil Service Commission has announced a Meteorological Aid examination from which positions paying from $2,498 to $3,727 a year will be filled. These positions are located in Washington, D. C., and vicinity, mainly in the U. S. Weather Bureau, Department of Commerce. A few positions in Alaska, in possessions of the United States, and in foreign countries, may also be filled.

To qualify in this examination, applicants must pass a written test and must have had from 1 to 5 years of appropriate technical or professional experience. Pertinent high school or college education may be substituted for all the experience required for $2,498 jobs and for part of the experience required for the higher-paid jobs.

Interested persons may obtain information and application forms at most first- and second-class post offices, from Civil Service regional offices, or from the U. S. Civil Service Commission, Washington 25, D. C. Applications must be on file in the Commission's Washington office not later than March 15, 1949.

Book Reviews

Astronomie (Sixth Edition), by Oswald Thomas. (Verlag Das Bergland-Buch, Salzburg, Germany.)

The first edition of this work was published in 1933. A review of it appeared in POPULAR ASTRONOMY, **45**, 289. The plan and material of this edition are quite similar to the first edition. However, discussions of the new developments have been added in the successive additions to keep the volume up to date. As a result the number of pages has increased from 574 to 611. The author's preface to the sixth edition is as follows:*

> The sixth edition is a reprint of the fifth, unchanged except in certain more important passages, and has been supplemented by an Appendix. In recent years the extraordinarily rapid development in the field of atomic-physical sciences which involves the subject-matter of the similarity of mass and energy has opened new perspectives especially in our cosmological concepts. Therefore in the Appendix there has been included a discussion of these problems—though as a matter of principle in only a suggestive, schematic or illustrative manner—to such an extent at least that the text of the book and Appendix is clear in all its parts. Concerning most recent stellar data reference might be made in conclusion to the author's Atlas of the Constellations, published by the same firm, which catalogues in a special list the essential details of some 1300 heavenly bodies.
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> May this new edition of Astronomy find as cordial a reception as its five predecessors which have appeared successively within eleven years. Renewed appreciation is due the publisher—"Das Bergland-Buch" Company, Salzburg—for the wide distribution of the book in the interest of popular education in astronomy and of astronomical science.
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> Vienna, August 26, 1948. O. THOMAS.

Analysis of Temperature, Pressure, and Density of the Atmosphere Extending to Extreme Altitudes, by George Grimminger. (The RAND Corporation, Santa Monica, California. November, 1948. Price $2.85, prepaid.)

This monograph was prepared to satisfy the constantly arising need in various investigations for information concerning the properties of the upper atmosphere at extremely high altitudes. It represents a first attempt to determine the vertical distribution of atmospheric properties over a range of altitudes extending from sea level out to interplanetary space, and brings together in one place the various types of information which bear on the problem. Values of temperature, pressure, and density in the atmosphere from sea level up to extreme heights of the order of 5,000 to 10,000 miles have been derived both at the equator and at middle latitudes. From sea level up to the height of the F_2-layer of the ionosphere the calculations are based on the best information available in the literature concerning the vertical temperature distribution, including the ionosphere temperatures which are derived by radio wave soundings. However, in view of the rather complete lack of knowledge concerning atmospheric conditions in re-

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*Translation from the German by Dr. Lindsey Blayney.

gions above the F_2-layer, calculations for these regions have been carried out on the basis of three different atmospheric models or theoretical concepts.

The atmospheric model I is based on the hypothesis or concept that there is an outer atmospheric limit far beyond the F_2-layer where the atmosphere is in thermal equilibrium with the interplanetary gas at a kinetic temperature of 10,000° K. This demands that the temperature continue to increase beyond the F_2-layer. The mean molecular weight is assumed to decrease with height in a specified manner. The atmospheric model II is based on the concept that above a certain height, situated somewhere above the F_2-layer, the mean free path of the gas particles becomes so large, and the collision frequency becomes so small, that the particles move over dynamical orbits under essentially free flight conditions in a gravitational field, and those moving fast enough are able to rise to great distances with but little chance of collision with other particles. If the effects of radiation are negligible, the temperature distribution in this region will be isothermal. Atmospheric model III is similar to model II inasmuch as it is based upon a free-flight dynamical orbit region ("exosphere") which is isothermal. In model III further consideration is given to the question of the temperature of the exosphere (based on the excitational collision process between electrons and oxygen atoms) and the height where it may be considered to begin; unlike model II, the composition is variable with height—the variation with height being determined by the conditions of diffusion equilibrium. In this model the effects of diffusion equilibrium are treated on a more rational basis than in model I.

In view of the wide variety of current investigations directly or indirectly requiring very high altitude atmospheric data, the report should be of value to workers in a number of fields. For this reason it is available, at a nominal cost to cover printing charges, through publication by The RAND Corporation.

Applied Architectural Acoustics, by Michael Rettinger. (Chemical Publishing Company, Inc., Brooklyn, New York, 1947. Pp. 189. Price $5.50.)

This book of 189 pages is a short compendium of information, suggestions, and opinions on architectural acoustics intended for use by architects, engineers, and contractors. As the author says, it is not a textbook, and it is mostly non-mathematical except for brief reviews of some of the basic equations applicable to the subject.

After a chatty introduction, the author begins with some elementary equations of acoustics and the more important basic definitions of American Standards Association Bulletin Z24.1. These equations, well known to acoustical engineers, will probably startle the architects, and certainly the contractors. Succeeding chapters on geometrical acoustics and reverberation afford a simplified picture of the interference between direct and reflected waves and a review of the three major reverberation equations and their background. As is customary in discussing reverberation, some of the material is a bit dogmatic.

Chapter IV has the all-inclusive title of Architectural Acoustics. It lists factors which influence absorptivity and criteria for choice of materials, along with the advantages of non-parallelism and diffusion. Because of the brevity of this chapter, the information useful to architects and contractors is thinner, so that the reader is referred by the author to other texts for material on such matters as optimal period. Because of the extreme condensation in this chapter,

it might have been preferable to refer the reader to Chapter V, and other material on soundproofing, rather than to have made oversimplified statements on the amount of transmission loss necessary in walls. A busy architect frequently takes sentences out of their context, particularly when context is in the following chapter. However, the warnings put out by the author against misuse of acoustical plaster will probably more than atone for the oversimplification of the isolation problem.

The treatment of motion picture houses, scoring stages, reverberation chambers for sound effects, and sound stages is the best part of this handbook. The experience of the author in these types of spaces well qualifies him to discuss them in detail. One might quarrel with the statement that 135 cubic feet per person provides comfort in a motion picture theatre. However, the quarrel would not be with the author but rather for an incidental nod to restricted seating practices. These chapters provide useful guidance to the architect in his thinking, although it is naturally impossible to include all the details which will make or break the design in the last analysis. The author has properly pointed out the advantage of separate rooms or semirooms for singers and announcers in order to provide useful degrees of fading without making the entire studio too dead.

The following chapters on design of broadcast studios, television studios, hospitals, churches, and auditoria are very sketchy and, for the most part, too brief to be of marked assistance, except perhaps in suggesting to the architect that he had better get an acoustical engineer to help him when he designs these types of spaces. The chapter on hospitals is more complete than the others and contains a number of valuable suggestions. The treatment of church and organ space design combines a moderate amount of acoustic information blended with artistic and emotional bits. The Ten Commandments of Architectural Acoustics should be valuable to architects and contractors, and it may be hoped that the accompanying treatment of the three types of microphones will be valuable, although this type of material is not well assimilated by a busy man who has not previously lived with directional patterns.

The book concludes with a chapter on measurement which is informative, although not sufficiently complete that the acoustically uninitiated can follow it and make the measurements. The collection of tables at the end of the book is useful, as well as the warning flag against averaging decibels.

It would have been difficult to make Applied Architectural Acoustics more complete so as to increase its value markedly without having it grow well beyond acoustics handbook size. If the book had been several times as thick, architects and contractors might not have read it either for pleasure or for profit. It is hoped that both these groups will read the present volume and find inspiration therefrom to consult a practicing acoustician, such as the author of the book, before reducing to paper and thence to materials those monstrosities which have for so long given the science its name of "acoustical correction."

C. P. Boner.

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